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Centre for Environment Education Nehru Foundation for Development, Ahmedabad 380 054

A Handbook of Environmental Education Activities for Teachers of Standards 5 to 8

Conserving Our Water Resources

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Handbook of Environmental Education Activities
for Teachers of Standards 5 to 8

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1st Reprint, 1994

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Centre for Environment Education
Nehru Foundation for Development
Thaltej Tekra, Ahmedabad 380 054.

CEE is supported by the Department of Environment, Forests and Wildlife,
Government of India.

Conserving Our Water Resources

SIKSHA MITRA
(Learning Centre)
Supported by : Swanirbhar

This booklet is part of an educational package on 'Conserving Our Water Resources'. It is available in English and Hindi.

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Introduction

Millions of years ago life evolved in water and water became a basic component of every living cell. Although water covers over three-quarters of the surface of the Earth, most of it is salty. A very small percentage is available as fresh water for our direct use. Hence, fresh water is a treasure to protect and conserve. We use water for domestic, agricultural and industrial purposes, for generating electricity, and transportation. The waste water generated by human settlements can be reused after proper treatment. In nature, the water cycle is constantly recycling water by evaporation, transpiration and condensation. Rainwater gets collected as surface water in rivers, lakes and seas, as groundwater in aquifers, or gets frozen as ice. Our fresh water resources are limited. By polluting or wasting water we will run short of a very valuable resource. We must, therefore, be careful to keep it clean and conserve it for ourselves and for future generations.

Goals

* to help children become aware of the importance of our natural water resources and the ecological processes that maintain them.

* to demonstrate and help children understand the different influencing factors that threaten the well being of our environment and how people can contribute to its improved management.

* to enable children to do what they can to conserve our water resources.

Target Audience

The package is designed for standards 5 to 8. However, most of the activities could be adapted to supplement various teaching-learning processes.

The theme, 'Conserving Our Water Resources' has been developed along five dimensions:

* importance of water
* uses of water
* water storage
* water quality
* reuse of waste water (recycling of water)

All these dimensions are interlinked and explain the need to conserve our water resources. The package is not exhaustive. You may add some more aspects while using the package to suit your needs.

This package is an attempt to integrate the five dimensions in an interesting and informative manner. It does not restrict itself to any one discipline but tries to touch upon a number of areas. It can be used in different contexts.

You may choose a particular component to suit what you are teaching and where and when you think it would be most effective to supplement the teaching-learning experience for yourself and your students. We would expect some behavioural changes in the students after using this package. They should be able to identify,

* reasons for conserving water
* simple ways to conserve water at home and in the school.

Activity Booklet

The booklet consists of activities, projects, case studies and stories. The activities and projects have been divided into four sections:

* Water Availability
* Water Use
* Water Conservation
* Spreading the Word

The first three sections are developed along the five dimensions mentioned earlier. While the first section highlights the importance of water and stresses the limited availability of usable water, the second section deals with the many uses of water. These two sections provide the background for the need to conserve water which is discussed in the third section. The third section deals mainly with how to prevent wastage and pollution of water by introducing the dimensions of water storage, water quality and reuse of waste water. The fourth section focuses on the need to spread awareness about conserving our water resources.

Each section carries a brief introduction or overview which highlights the major concepts and information that it contains. This introduction is followed by a set of activities, each of which is accompanied by some background information. In some instances this information is supplemented with case studies. The activities are aimed at making the students aware of the importance of our water resources and the need to conserve them. The intention is to motivate them to take responsible actions leading to the conservation of water. The activities help in developing skills of observation, measurement, data collection, drawing, model making, decision making, analyzing, news gathering and creative writing.

Each activity includes a statement of the instructional objective, background information for the teacher, the main subject area covered, duration, recommended group size, setting (indoors or outdoors), a step-by-step procedure and a few questions to evaluate student learning. Most of these activities can be conducted in a class period. The activities are developed as supplementary exercises designed for integration into existing courses of study. You may pick and choose from the activities, as each activity is designed to stand alone. However, the activities have been placed in an order that can serve as an aid to their use.

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Water Availability - Overview

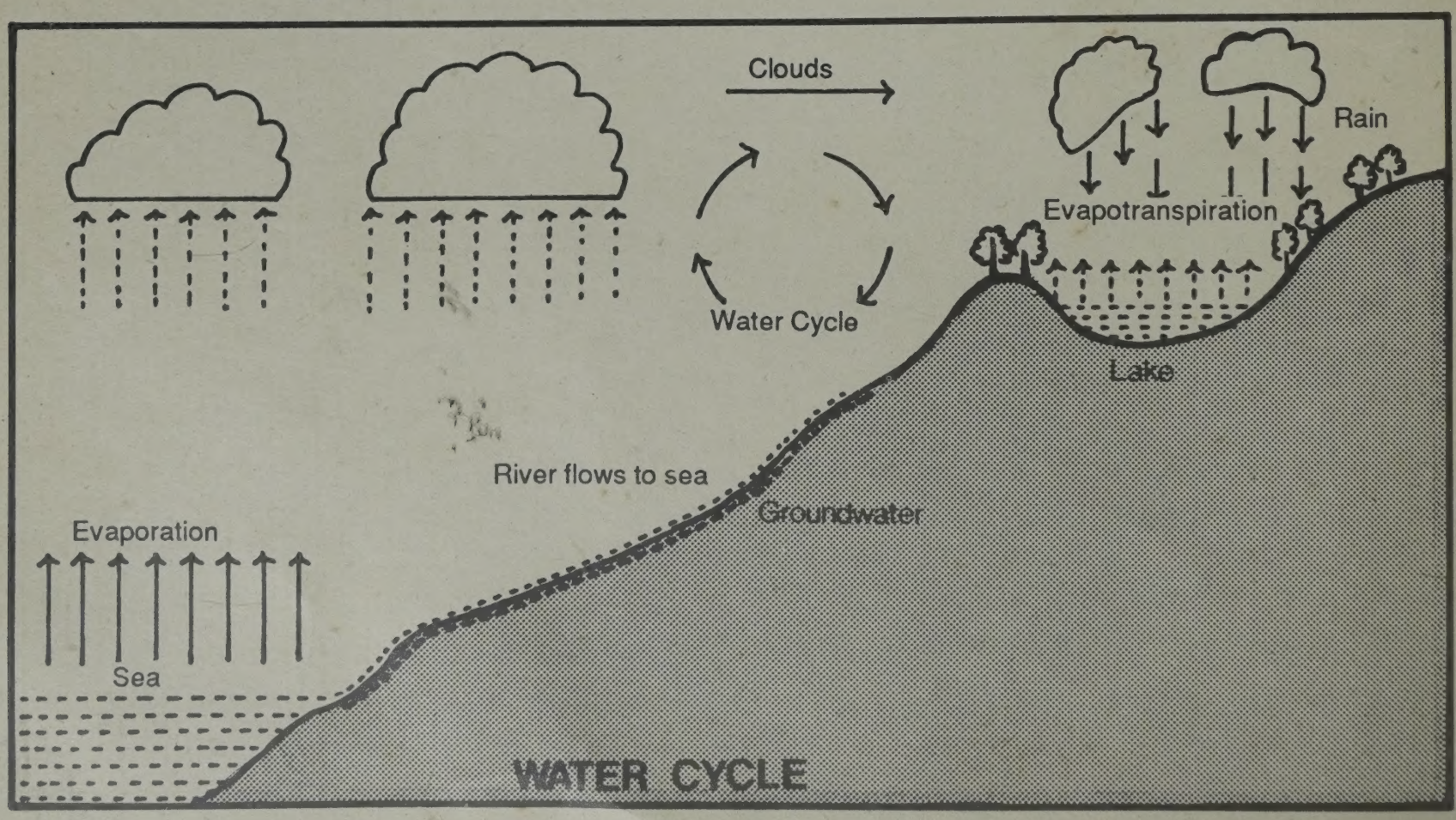
Water goes through a never-ending movement from one stage to another. It moves from the oceans to the sky as vapour to form clouds, falls back to the Earth as rain, and finds its way to the oceans again through rivers and streams. This movement of water is called the water cycle.

Water in the oceans, lakes and streams is heated by the Sun and evaporates. Water also evaporates from plants. This is called transpiration. Water vapour rises into the air; as it rises, it cools and condenses, and forms little droplets of water that make up the clouds.

Within the clouds, tiny droplets of water come together to form larger and heavier ones. When the air around the cloud cools, these fall as rain, or when the temperature is below freezing point, as snow. Water that falls from the clouds -- in the form of rain or snow -- is called precipitation.

Some of the rainwater seeps through the soil and is stored underground. This is called groundwater. Plants absorb water from the soil and return it to the atmosphere during transpiration. Much of the remaining rainwater finds its way to rivers and streams which transport it to the oceans. From the oceans it evaporates again. The cycle begins anew.

The world's water resources seem enormous -- nearly three-fourths of the Earth's surface is covered by water. But not all this water is available for our use. Ninety-seven per cent of this water resource is in the oceans and is salty. The glaciers and ice-caps lock away another two per cent. Even less than one per cent is the fresh and usable water of lakes, ponds, rivers and groundwater.



Where is the usable water and how do we get it ? Approximately one per cent of the water on Earth is fresh water and is available for our use from three sources:

(i) groundwater
(ii) freshwater lakes
(iii) rivers.

Drawing mainly from these three sources, most living creatures have to satisfy their needs.

Animals, birds and insects mainly depend on surface water sources such as rivers and lakes. Plants generally make use of groundwater.

Human beings draw upon both surface water and groundwater. Through the use of technology, they can divert rivers, build dams and sink wells to make more of this fresh water available. But in spite of all this technology, the fact remains that the total quantity of fresh water available is limited.

In the following section, a simple activity demonstrates how little fresh water is available for our use.

1

Before We Begin

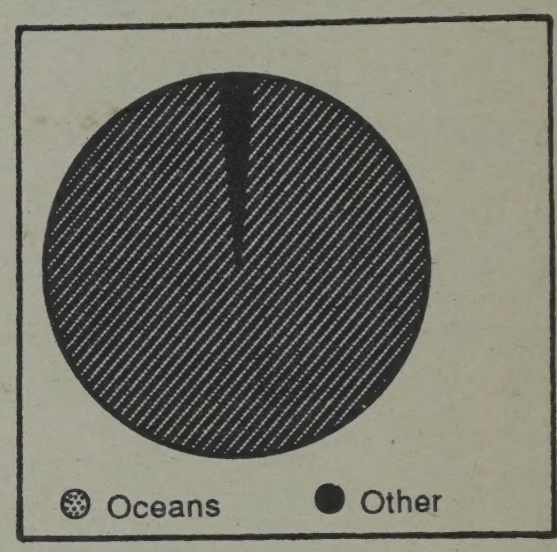
When we use water for our daily activities we hardly pause to think that we are using a very precious resource. This seemingly enormous resource covers nearly three-fourths of the Earth's surface. However, not all of it is available to us.

The oceans contain 97 per cent of the water, but all this is salty. The glaciers and ice-caps make up two per cent. Less than one per cent is the fresh and usable water of lakes, ponds and rivers, and groundwater.

The precious supply of fresh water is continually replenished by rain. Rivers, lakes and wells would go dry, crops would wither and all life would come to an end without this replenishment.

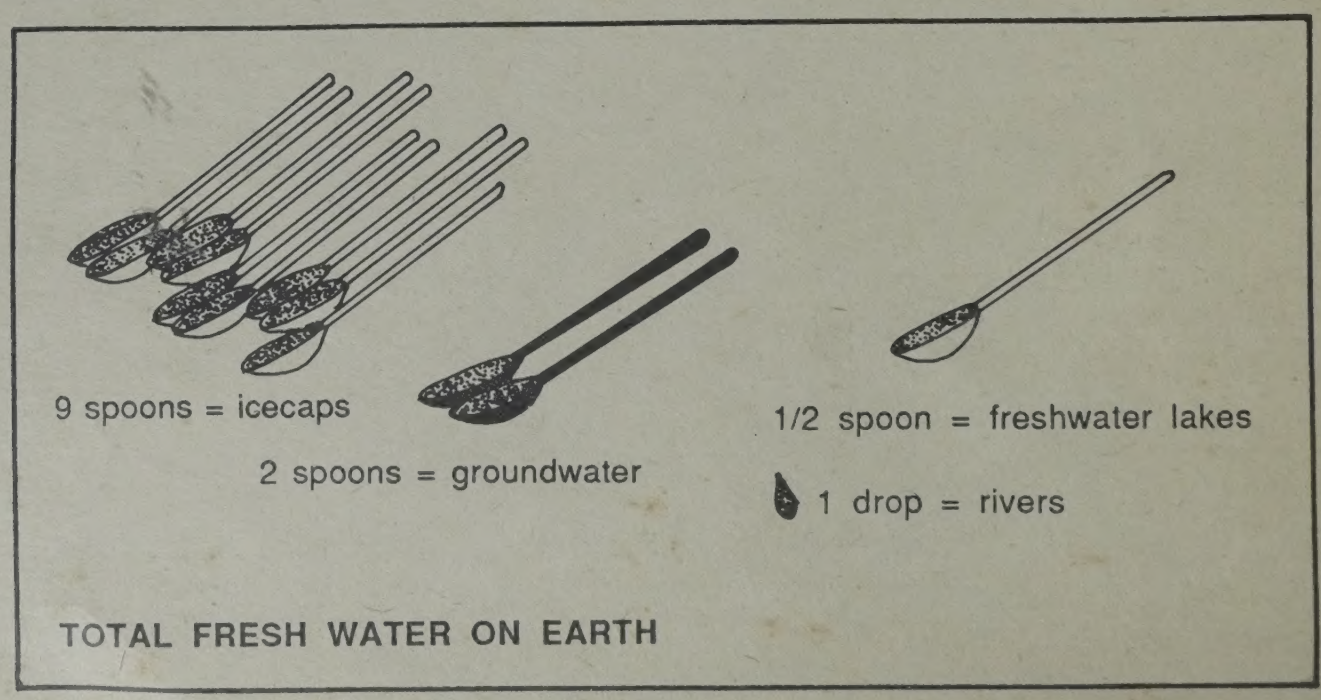
The following table gives the percentage distribution of water on the Earth.

Oceans	97.2
Ice-caps	02.0
Groundwater	00.62
Freshwater lakes	00.009
Inland seas and Salt lakes	00.008
Atmosphere	00.001
Rivers	00.0001
Total	99.8381



Based on these percentages, the following activity demonstrates in a simple but effective way this distribution.

Students may be surprised to see how small is the quantity of water available for our use.



A Drop of Water

1

Subject	Group size	Materials
Social Studies	9 - 10	Large container (2.5 litre volume), small transparent container, two small dishes, measuring cylinder, teaspoon, ink-dropper.
Place	**Duration**	
Class room	45 minutes	
	Suitable time/season	
	Any time	

Objective

To demonstrate to students the distribution of water on Earth.

Activity

Divide the class into small groups. Ask each group to measure 2200 ml of water in a container. If a measuring cylinder is not available, a soda-water bottle of 200 ml capacity may be used.

Tell them to assume that 2200 ml represents the total water available on Earth.

Ask them to take a teaspoon and measure out 12 spoonfuls of water into a small transparent container. Tell them that this is the total amount of fresh water on the Earth, including the water found in lakes, rivers and ice-caps and as groundwater. The water that remains in the large container represents salty water found in oceans and seas.

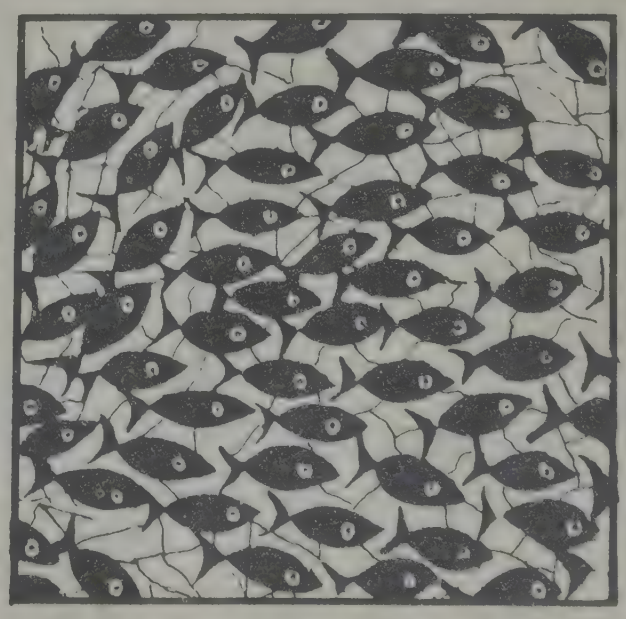
From the container with 12 spoonfuls of water, let the students measure out two spoonfuls into a dish. This represents the groundwater.

Let the students take another dish and remove into it half a spoon of water from the container which now has 10 spoonfuls of water. This represents the water found on the surface of the Earth in freshwater lakes.

From the remaining water in the smaller container, let the students remove one drop using an ink-dropper. This drop represents the amount of water to be found in rivers.

The smaller container will now have about nine spoonfuls of water left in it. Tell the students that this represents the amount stored in ice-caps.

Ask the students to compare the quantities of water in the various containers.



Evaluation

Ask the students how the fresh water stored as ice becomes available to us.
Ask how people use sea water and whether it can be converted to fresh water for our use.

Uses of Water - Overview

We have seen that the total amount of fresh, usable water is limited. But few of us are conscious of the number of demands on this limited amount of water. We may not even be conscious of the various things for which we use water, how many times in a day we use water or how much water we need.

The direct, personal uses of water are the first which come to mind when we talk about water uses -- these may include drinking, bathing and washing. Then we may think of other obvious uses -- water for agriculture and for power generation. When we think more about it, we will find that water touches every facet of our lives -- the food we eat cannot be grown or cooked without water. The clothes we wear, the houses we live in cannot be made without water. The paper this book is printed on cannot be made without water.

And it is not just human beings who need water. No animal or plant can survive without water. We may not always remember this, but man's overuse and misuse of water may affect plant and animal life adversely.

Water uses may be broadly categorized as follows :

Water for Life: Life began in water and water is a basic component of every living cell. It acts as a medium for important life-processes and

chemical reactions, and transports food and waste products. The proportion of water may vary from one plant or animal to another. A tree may be 40 per cent water and some aquatic plants may have almost 90 per cent water. Approximately 65 per cent of the human body is water. Living organisms have to take in fresh water to replace what they lose through metabolic processes.

Water for Agriculture: Food cannot be produced without water. Vegetables are 80-90 per cent water and milk about 87 per cent water. Crops, livestock, all need water. Agriculture is the major consumer of water in India.

Water for Industry: Almost all industrial processes need water. It is needed for the manufacturing or processing of ores, textiles, chemicals, paper, food, etc. Water is needed as a solvent, as a medium, as a cooling agent, as a cleaning agent, to name just a few of the industrial uses.

Water for Power: Almost all modes of power generation require water -- from hydel power, where falling water turns turbines to produce power, to nuclear reactors, where water often acts as a coolant.

Water for Domestic Use: Cleaning, cooking, washing, bathing, sanitation -- all these require water.

Water for Waste Disposal: Whether it is domestic sewage or industrial effluents, water is vital for waste disposal.

Apart from these uses, water is also needed for transportation -- most of the world's traded goods move along seas and rivers.

Not only are there so many demands for water, these demands are increasing every day. The number of people is increasing and our lifestyles are also changing and becoming more demanding of water.

Of the total water used in India by AD 2000 , the proportions that will be put to different uses have been estimated as follows

Use	%age of total use
Agriculture	93.37
Livestock	1.08
Industries and Power Generation	1.26
Municipal & Rural Water Supplies	3.73
Total	99.44

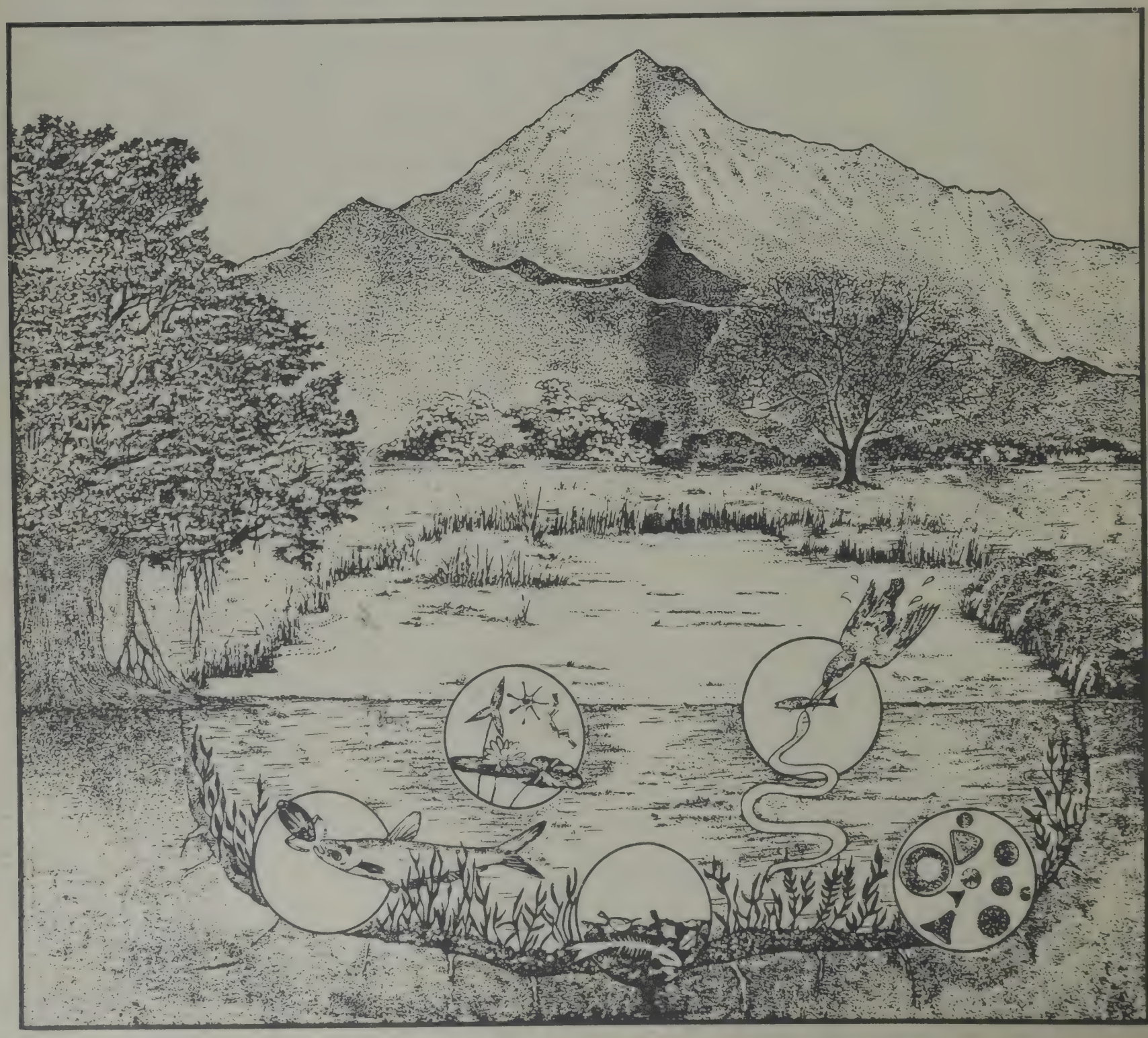
The following activities attempt to demonstrate how many uses there are for water and how these uses are increasing.

2

Before We Begin

All living things -- plants or animals -- need water to live. All organisms need to take in freshwater to replace metabolic losses and maintain life processes. Apart from this, some organisms may need it for living in, while still others might not be able to breed except in water. Though the amounts of water required and the tolerance to lack of water are different for different organisms, none can do entirely without it. Plants and animals which live in places where the availability of water is low, are adapted structurally and functionally to cope with these conditions.

Not only is the availability of water important, the quality of water is also of concern. When too much organic matter, toxic material or other undesirable substances are introduced in water, the water becomes polluted. Plant and animal life suffer and the water may become impossible to treat for human consumption.



We All Need Water

2

Subject	Group Size	Suitable time/season	Materials
Science	Entire class	Any time	Magnifying glass (if available)
Place	**Duration**		
Outdoors	One hour		

Objective

To make students aware that a single water source is used by many living things.

Activity

Students should identify a common water source (small pond, tank or public water tap) near the school or in their neighbourhood. They should observe the activities around the water source during the course of a day or a few days.

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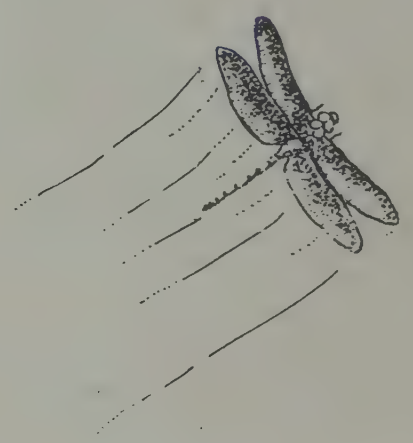
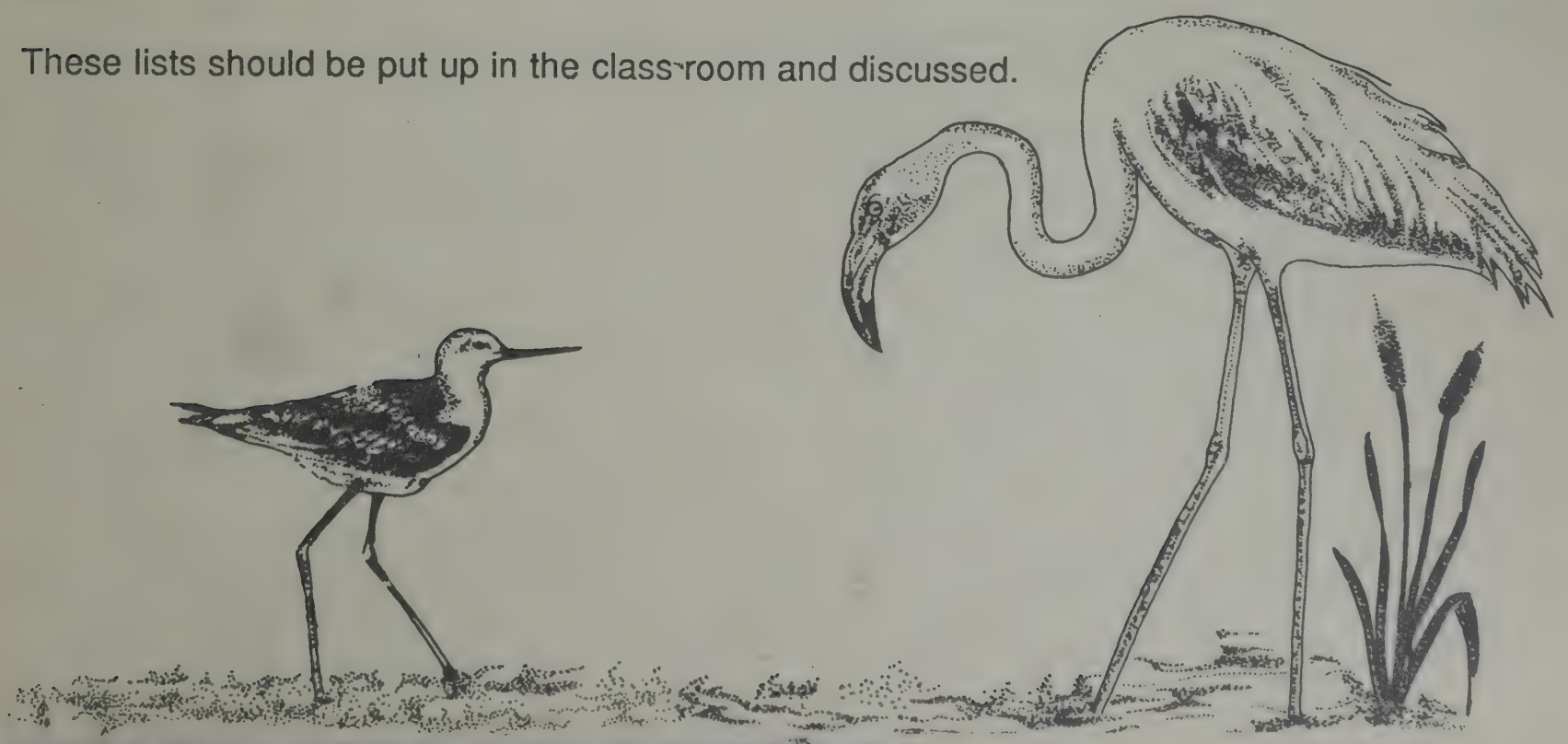
Students should note down all the activities such as washing, cleaning, bathing. They should consider not only human activity but also observe carefully how other living things -- animals, birds, insects and plants -- use the water source.



Students should also dig out some soil from one or more places around the water source. They should observe the various kinds of organisms that live in the soil -- earthworms, insects,etc. They may use a magnifying glass for this.

They should make a detailed list of the different ways in which water is used. They could fill out a check-list similar to the one given.

These lists should be put up in the class-room and discussed.



2 contd.

Source Handpump Location Corner of --- Road

Time	Who used	For what	Remarks
6.30 a.m	7 women from neighbourhood	Filling water pots	
7.00 a.m	2 workers	Drinking	A lot of water went waste
11.30 a.m.	Some sparrows	Bathing in puddle	
All the time	Grass	Growing	The patch around pump is very green
All the time	Mosquito larvae	Observed in the puddle	Something needs to be done

Evaluation

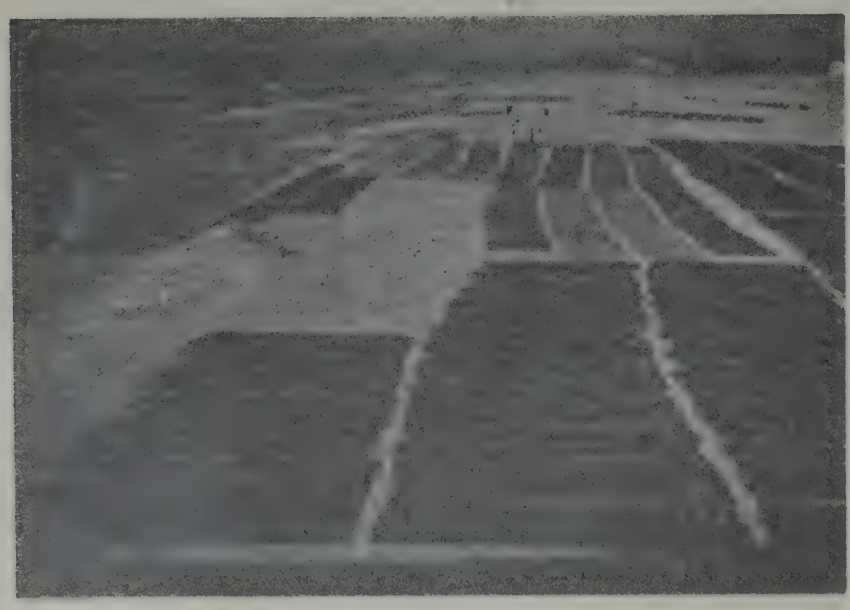
Are there certain times of the day when the source is used more than at other times?
Is there any danger of the source getting polluted?
What could cause this?
Which of the above activities would stop if the supply were to get polluted?
Can the students suggest some ways of conserving the existing water source or improving its use?
If the source visited is a pond or stream, what would happen if it gets flooded? If the source is a handpump, what would happen if it breaks down? If the source is a tap, what if the supply stops for a day?

3

Before We Begin

Water use is such an automatic and habitual activity that we often do not realize how we use water every day. We put it to many direct uses in the house -- cooking, washing, bathing, cleaning, drinking. There are also many indirect uses -- the food we eat, the milk we drink, the clothes we wear -- all these are produced through the use of water. But we seldom pause to think how dependent we are on water. Even becoming aware of how many uses there are for water may make a difference in our water use.

WATER BEING USED FOR WASHING AND DYEING...



3

Water and I

Subject	Group Size	Suitable time/season	Materials
Drama	Entire class	Any time	None
Place	**Duration**		
Classroom/ Outoors	45 minutes		

Objective

To become aware of how important water is in almost every aspect of our life.

Activity

The activity requires some space for a student to dramatize a use of water.

Students should sit in a circle.

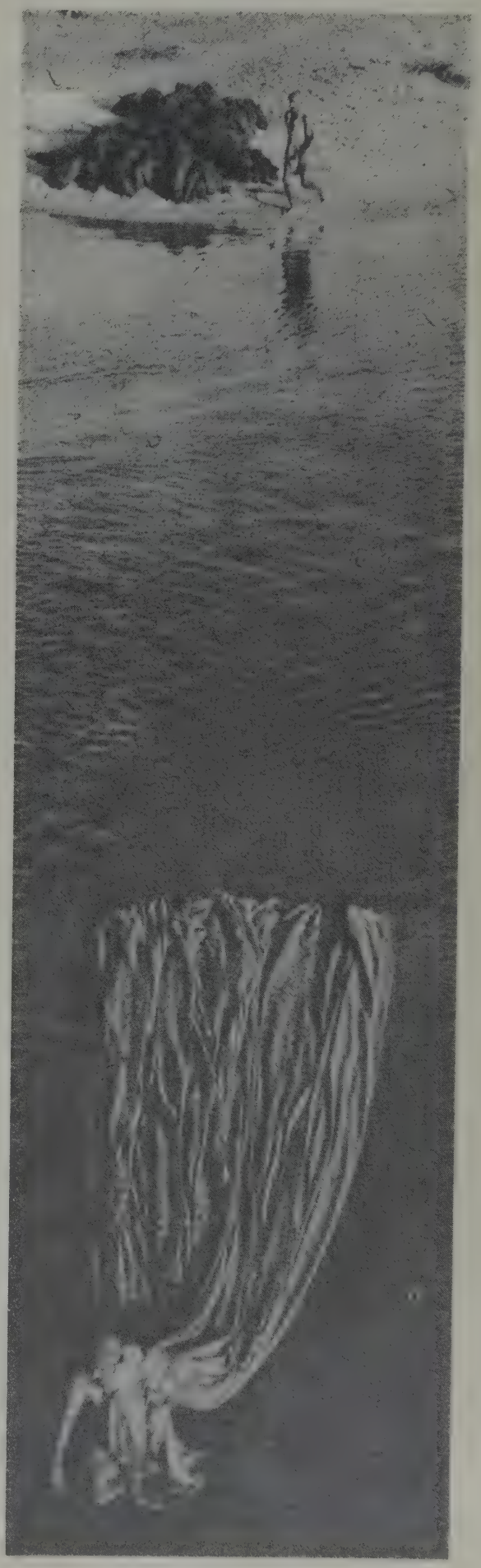
Ask the students to think of some of the activities in their daily routine which require the use of water, for example, cleaning teeth, bathing, washing clothes, watering plants etc.

Let each student, in turn, dramatize an activity involving the use of water, within a specified time. Only mime should be used, no speech.

The other students can guess the use of water being portrayed. List out all these uses of water on the blackboard.

Extension/Variation

Next, ask the students to recall one event that took place the previous day. Each student can say one sentence, beginning with 'Yesterday I ....' The other students must think of ways in which water could be connected with this activity. For example the sentence may be 'Yesterday I received a letter.' In this case, the responses may be 'The letter came by sea mail' or 'The sender stuck the stamps on with water.' The winning sentences are those which have nothing to do with water -- but are there any such ?

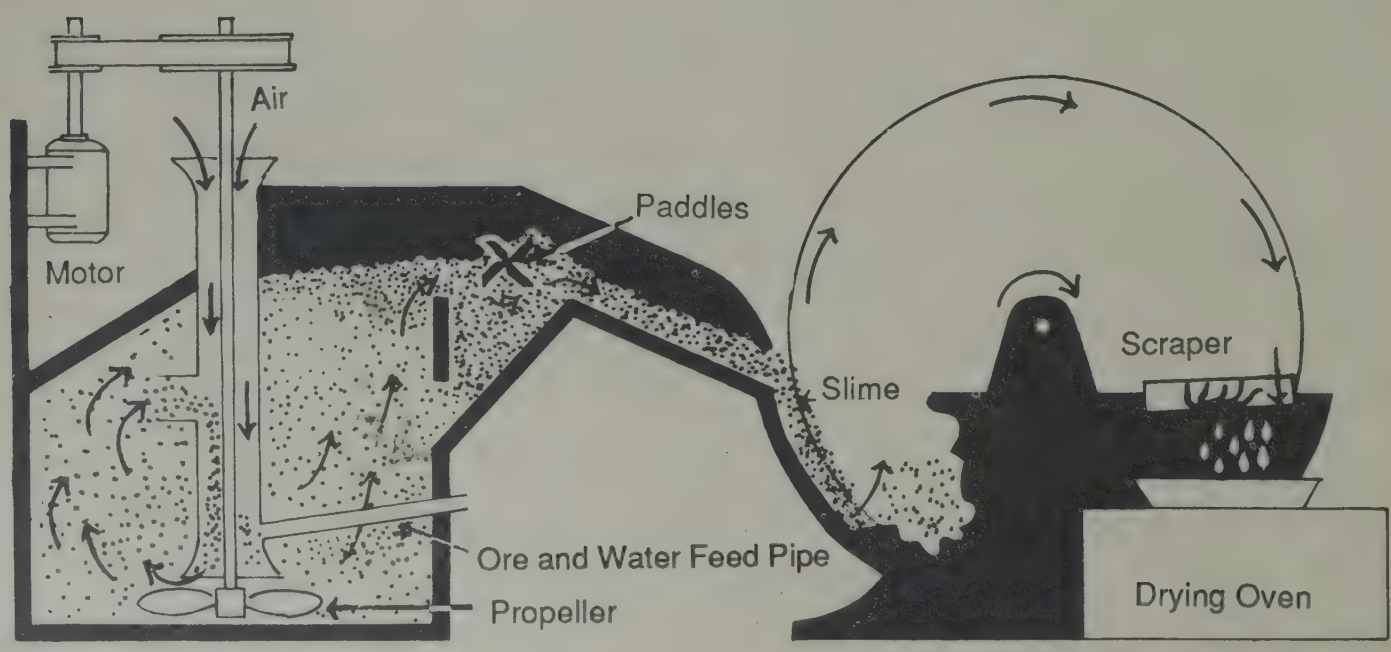


... IN THE SABARMATI RIVER, AHMEDABAD

4 Before We Begin

Water is used in industries mainly for power generation and in manufacturing processes. Almost 60 per cent of the world's industrial demand for water is for power generation. Of the 40 per cent used in manufacturing processes, the bulk (two-thirds) goes to the following five industries: primary metals, chemical products, petroleum refining, pulp and paper, and foods. There are very few manufacturing processes which do not use water at some stage. Be it a cottage industry or a high technology process, water enters the cycle somewhere. There are varied uses for water in industry -- as a solvent in chemical processes, as a medium for heat transfer in power plants, as a cleaning agent, as a coolant. Not many of us are conscious of how much water is used in the manufacture of all the things we take so much for granted. For example, it takes about 100 tonnes of water to produce a tonne of steel or paper; about 30 tonnes to produce a tonne of plastic; and 70 litres to refine one litre of petrol.

Besides consuming a lot of water, industries also pollute available water resources by discharging wastes which lead to a deterioration in water quality. Industrial pollutants affect not only surface water bodies such as lakes and rivers, but also seep down and pollute groundwater. It is estimated that more than two-thirds of India's water resources are polluted. An important cause for this is that many industries have not installed waste-water treatment facilities.



RECOVERY OF MINERALS BY FLOTATION PROCESS

4

Water in Industries

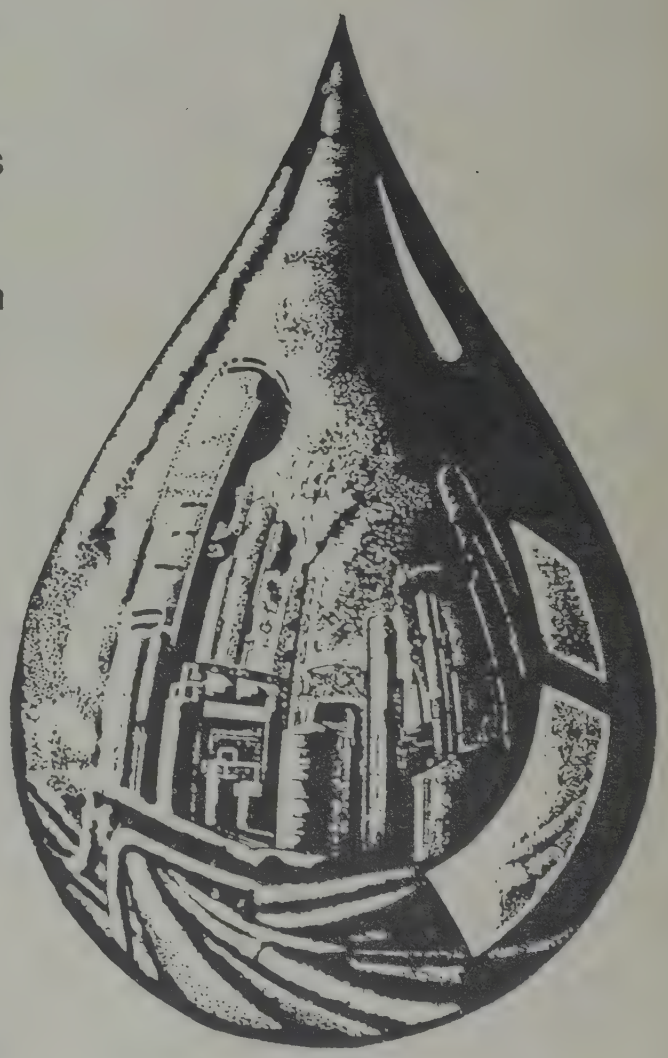
Subject	Place	Duration	Suitable time/season
Science/Social Studies	Factory/ Craftsman's workshop	Two hours for the visit and 30 minutes for discussion	Any time
	Group Size Entire class		**Materials** Writing materials

Objective

To emphasize that every industry consumes water at some stage or the other.

Activity

Initiate a discussion on the industrial uses of water (You could make use of the information given in the examples.) Point out that different industries may need different qualities and quantities of water, for different purposes, at different stages. Take the class to visit any local manufacturing operation. This could be a small or large factory, a cottage industry or a local craftsman such as a painter, potter, dyer, or blacksmith. Ask them to observe specifically the stages of the process in which water is needed; the quality and quantity needed; the source used and whether the operation produces any wastes which may contaminate the water around.



Extension/Variation

Ask students to collect information on water use in different industries. They could do this by going through their own textbooks; by talking to their parents/neighbours who may be working in manufacturing processes.
Ask the students to make a mud pot. Let them observe how much water they use in the process

Evaluation

On their return to the class, students may prepare a short write up on the process they have observed and illustrate it with a flow chart of the process, highlighting the passage of water through the manufacturing process observed. (See examples given.)
Can this industry use any substitute for water in the various steps?

4 contd.

Examples

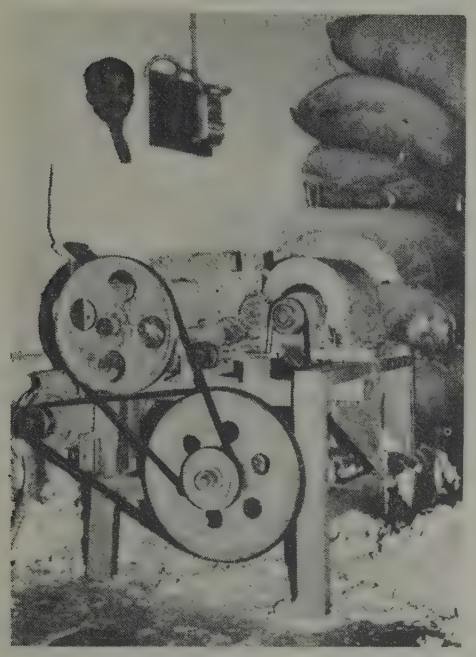
Making a Mud Pot

The first step in making a pot is to select the appropriate clay. The clay is cleaned by mixing it with WATER and passing it through a sieve so that large impurities are removed. Then the clay is brought to the proper consistency by mixing with WATER and other materials such as ash and dung. It is then kneaded well with hands or feet. After this, the clay is shaped to make a mud pot by 'throwing' on the potter's wheel -- keeping the 'wheel head' moist with WATER and smoothing the pot with wet hands as the pot takes shape. Then the moist pot is 'beaten' with a wooden piece to make it smooth, and finally it is baked.

How Paper is Processed

Most of the paper we use is made of wood. First, the log of wood is stripped of bark and then made into pulp by either grinding it with WATER or cooking it with chemicals. Then this pulp is sieved and washed with WATER to clean out impurities. Then the pulp is beaten in a large mixing machine and mixed with WATER. After this, the fibres in the pulp are trimmed in a special machine. At this stage, the pulp is 99 per cent water and 1 per cent fibre. The pulp is fed into a machine which removes the water from the pulp and vibrates the pulp so that the fibres interlock to make a mat. The mat then passes through a series of rollers which squeeze out the water. After this, it is dried.

contd. 4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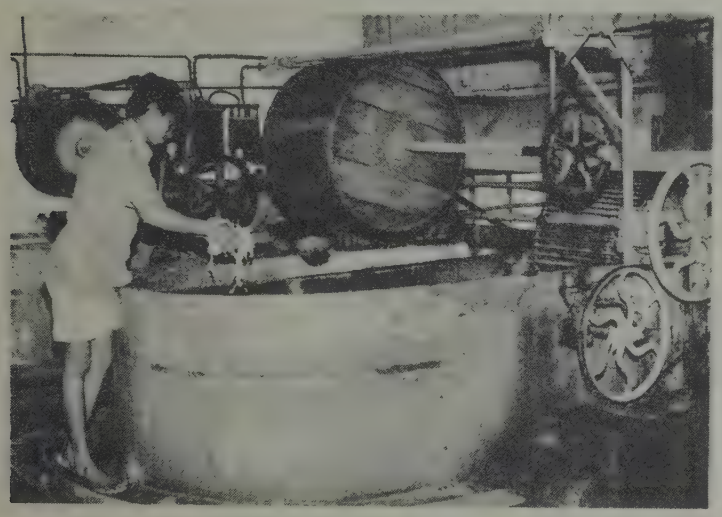
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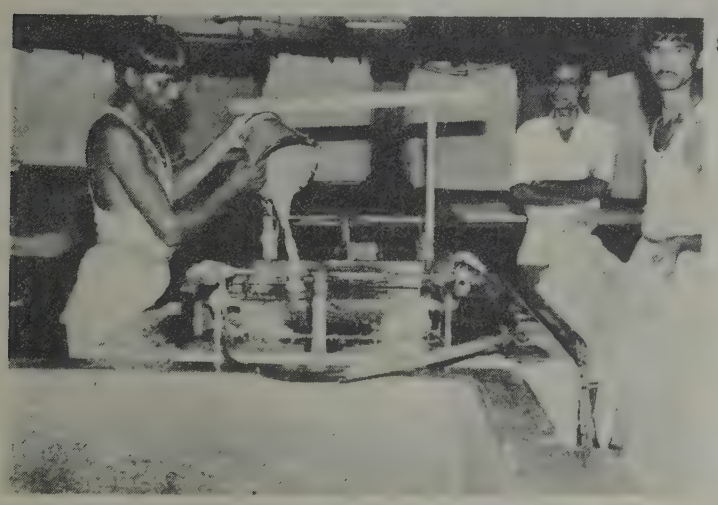
THE PROCESS OF MAKING PAPER USES LARGE AMOUNTS OF WATER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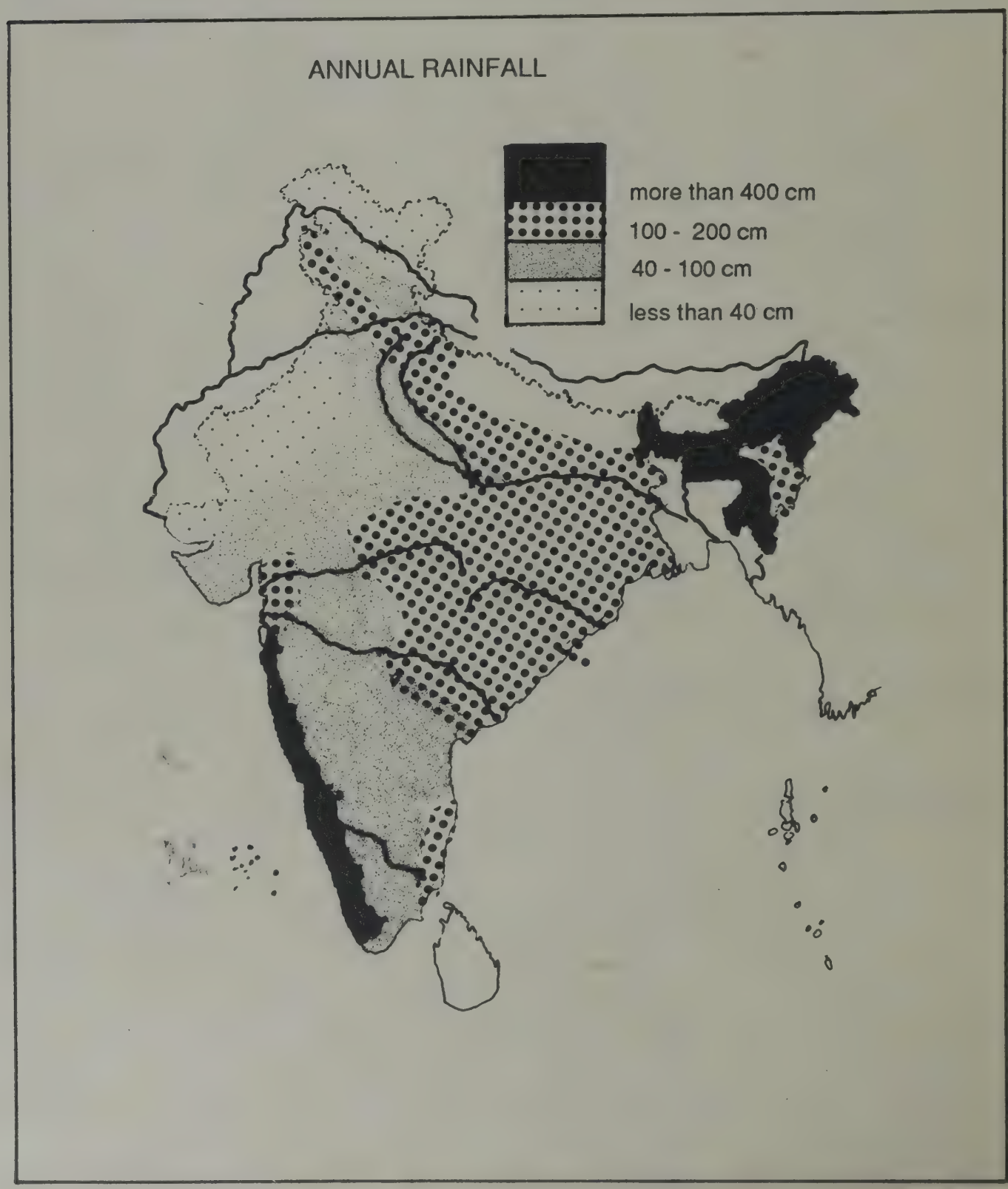
5

Before We Begin

The main demand for water is in agriculture. Over 90 per cent of all the fresh water consumed in the country and approximately 73 per cent of it consumed globally is for this purpose. It takes 500 kilos of water to produce 1 kg of wheat! Water availability and rain are major concerns of the farmer. Temperature, soil conditions, good seeds, availability of pesticides and fertilizers -- all these may be important for a good crop. But water is the most essential prerequisite. No matter how fertile the land, if there is no water, plants will surely die. This is because the roots of plants can absorb nutrients only when they are dissolved in water. When there is no water, plants die of thirst as well as hunger. Farmers are concerned with whether water will be available, how much will be available, and when it will be available.



Water to Grow Our Food

5

Subject	Place	Duration	Materials
Science/Social Studies	Home	Variable	Atlas, Radio or Television
	Group size	**Suitable time/season**	
	In groups	Any time	

Objective

To emphasize how water availability affects agricultural operations.

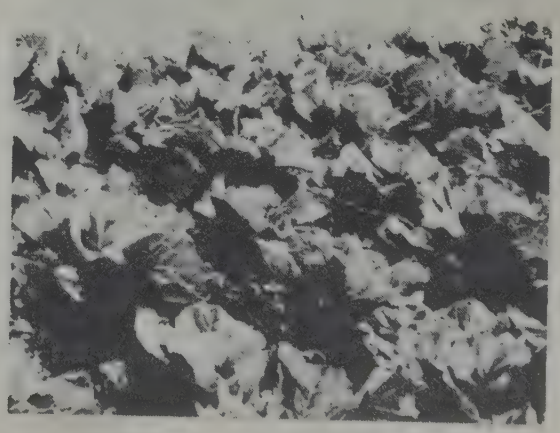
Activity

Let the students form small groups of three or four. Let each group visit a farm. Through observations and through talking to the farmer, the students should find out the different crops grown, why these particular crops are grown in the region, the amount of water needed to grow the different crops, whether the fields are irrigated or not and whether any water conservation measures are practised. Let them also ask the farmers what crops they would grow if they had as much water as they wanted and what crops they would grow in a drought year.

With the help of an atlas, let the students compare the following maps (i) rainfall in different parts of the country and the crops grown in these areas (ii) irrigation in various areas and the crops grown (iii) rainfall in various areas and the land use.

Extension/Variation

Ask students to list out the agriculture-related programmes that appear on radio or television. Divide the class into seven groups and ask each group to carefully monitor the news and agriculture-related programmes on radio and/or television for one particular day of the week. Let the class prepare a chart which the concerned group can fill in everyday. At the end of the week, let them list the various water-related issues which are of concern to farmers. Students may discuss how some of the water conservation measures suggested in the programmes can be used in their locality -- in farms, gardens, or trees in the locality.



6

Before We Begin

During the first half of this century, world water use doubled. It is expected that it will again double by 1990. Not only are there more people, but our life styles are also changing. These changed life styles may mean new uses for water, increased amount of water used and changes in the kinds of wastes we dispose into the water system. (Also see case study 'Indus Valley') On the whole, the world is constantly moving towards life styles which consume more of most resources, including water. Not only do most of us tend to use more for our personal uses, but we also use many goods and services that our parents or grandparents did not. Processes used to produce many of these goods are water intensive.

Due to our changed life styles, we are also polluting our water resources more. Increased use of detergents, soaps and other cleaning agents in homes, and increased industrial activity result in deteriorating water quality.

Here is a simple exercise to see how water use has changed over time.

6

Yesterday and Today

Subject	Place	Duration	Materials
Social Studies	Home	Variable	Writing materials
	Group Size	**Suitable time/season**	
	Individual	Any time	

Objective

To find out how various factors related to domestic water use have changed over three generations.

Activity

Ask the students to make a chart similar to the one given below, with relevant additions or deletions. Ask them to interview a grandparent (or any person of around 50 years in the neighbourhood) and a parent with the help of these charts. The information gathered should be about the situation when the grandparents and parents were of the student's age. After the interview, let the students fill out the chart for themselves.

Students may be given two days to finish this exercise.

Evaluation

The class may discuss whether they think water is more easily accessible now or in the past, whether any new uses of water have come up, whether we use more water in our homes today than our parents or grandparents did, what effect present-day habits (use of soap, detergent etc.), have on water quality as compared to past habits, what the implications of changing habits are on sewage, waste treatment and waste disposal.

- How did you clean your teeth? (tooth-paste, *datun* etc.)

Grandparent	Parent	Me

- Where did you bathe? (At the river, tank, home)

Grandparent	Parent	Me

- What did you use as a cleaning agent? (soap, *besan*, etc.)

Grandparent	Parent	Me

- What was the source of water for the house? (river, community well, house well, taps etc.)

Grandparent	Parent	Me

- How far was the water source from the house?

Grandparent	Parent	Me

- Who collected the water?

Grandparent	Parent	Me

- Where were the clothes washed?

Grandparent	Parent	Me

- With what were the clothes washed?

Grandparent	Parent	Me

- What kind of toilets did you have? (dry latrines, flush etc.)

Grandparent	Parent	Me

Based on an activity from *Energy Conservation Activities for Elementary Grades*, Iowa Developed Energy Activities Sampler, State of Iowa, Department of Education.

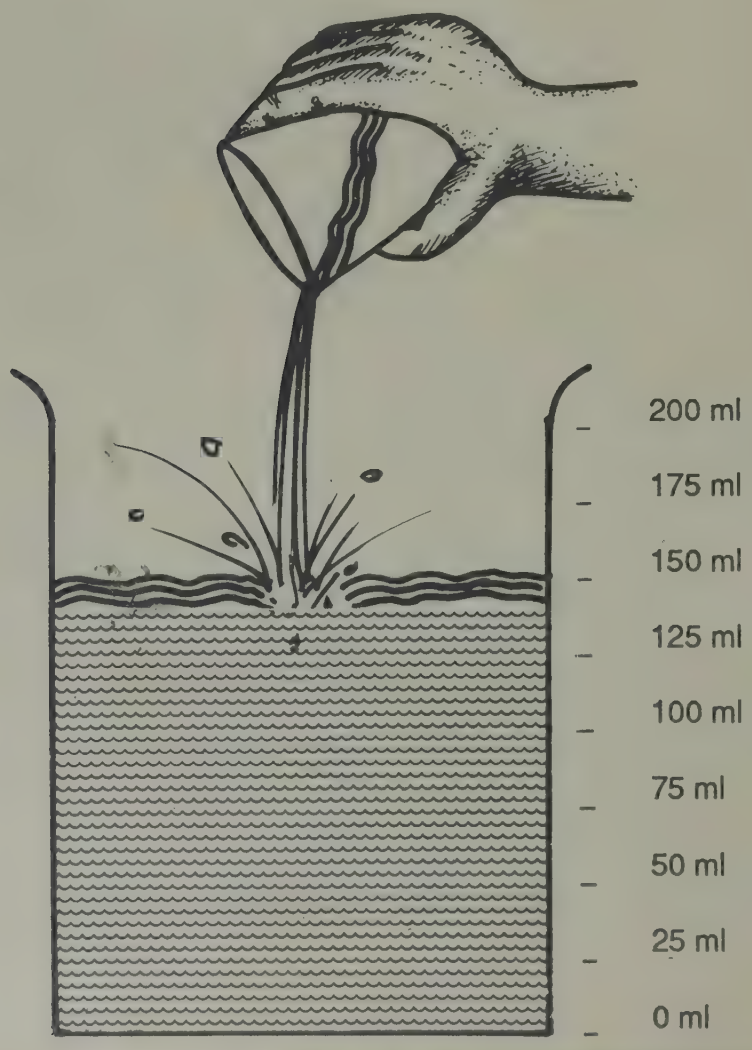
7

Before We Begin

'We got *very little* water today'. 'I don't use *much* water for a bath.' '*A lot* of water is wasted because of the dripping tap.' All these statements refer to quantities of water. But when we start talking about quantities, we need an accepted standard of measurement. If there is no standard, there could be a lot of confusion. One student might say he drinks eight glasses of water and another might say he drinks ten. Unless we know how much water each one's glass holds, we cannot decide who drinks more. We can overcome this problem by expressing the amount in terms of a standard. While there is nothing sacred about such standards, use of standard measures ensures uniformity. India, as most other countries in the world, uses the metric system. In this system, the measure of volume is a 'litre', which is a tenth of a cubic metre.

Once such a standard measure of capacity is chosen, the next step would be to calibrate a measuring device in terms of the standard measure i.e., find out the relation between our measuring device and the standard. For example, if we choose a tumbler or mug as our measuring device, we must find out how many such tumblers or mugs of water a bucket commonly used holds.

Once a standard has been established and instruments calibrated, we can begin to measure in a more systematic way.



How Much?

7

Subject	Group Size	Suitable time/season	Materials
Science/ Mathematics	Individual	Any time	Any standard measure, water containers.
Place	**Duration**		
Home	30 minutes for calibration		

Objective

To standarize a way of measuring water use and estimating personal water use.

Activity

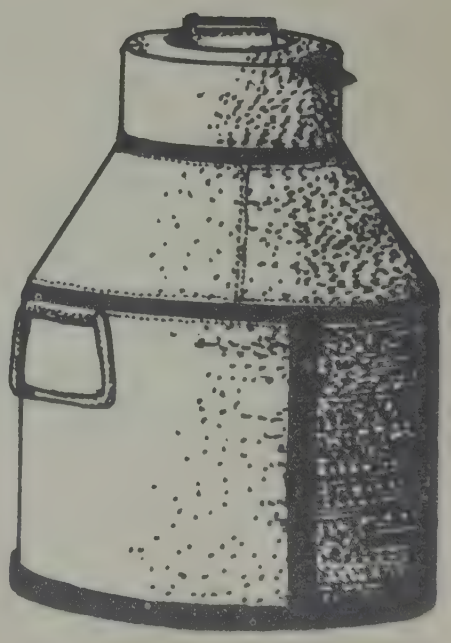
After a discussion on the need for standard measures, let the class decide what common measure of capacity they would like to use. If they decide to use the litre, a soda or milk bottle, if available, can be used for calibration. Otherwise, the milkman or oil merchant may have some containers defined in litres. Alternatively, some other local measure can be used. Most kitchens would have some vessels of standard capacity. With the help of any of these, ask each student to calibrate the following utensils in the house: (a) tumbler which they use for drinking,(b) bucket they bathe from,(c) *matka* or drinking water storage vessel,(d) mug-like utensil or *lota* used for pouring water.

For example, a milkman's measure = 1/4 litre

If a small matka holds 4 1/2 measures, this would indicate a capacity of 1.125 litres.

If a bucket holds 10 1/2 such mud pots it would have a capacity of 11.8 litres.

Once the students have calibrated their vessels, let the class discuss their results with special reference to how correct such a calibration is. Would they be able to judge whether the vessel held exactly 4.5 measures, 4.35 or 4.6 measures? Can they think of any way to reduce these errors?



7 contd.

Once they have calibrated the containers as best as they can, let them keep a diary for three days. This can be as follows:

Date	Time	Use	How much	Conversion
12.12.88	6.00 a.m.	Cleaning teeth	2 mugs	1 mug = 425 ml Water used=2x 425 = 850 ml.
12.12.88	6.15 a.m.	Bath	1 bucket	1 bucket = 11.8 lit Water used= 11.8 lit
12.12.88	11.00 a.m.	Washing hand	1 mug	425 ml

Let each one calculate the average amount used for each activity. On the basis of this, let the class prepare the following chart :

Amount of Water Used					Total amount of water used in a day
Name of student	Cleaning teeth	Bathing	Drinking	Any other activity	

Evaluation

Why is there a difference in the quantity of water used from person to person?
What are the possible ways in which water can be used most efficiently for each use?
Each student should try to identify the causes of water wastage in his daily routine.
Each student should think of possible ways of saving water in his/her routine activities.
Imagine that very little rain falls this year. Your city is running short of water. What restrictions would you suggest in the use of water to make the supply last as long as possible?

Water Conservation - Overview

Human population is increasing very rapidly. India alone will have 100 crore people by the end of the twentieth century. With an increase in population, the need for water is also increasing. But the amount of water available is limited. This means that with every person born, the amount of water available per person becomes less.

Population growth is not the only cause of strain on our water resources. We are also misusing, wasting and polluting what is available. We often allow taps to drip at home and at the community standposts. Where water is not scarce, we tend to over-water our fields. We pollute our surface water sources with human and animal excreta. Bathing, cleaning and washing along the banks of ponds, streams and rivers also pollute the water. So does the discharge of industrial wastes. Chemical fertilizers, pesticides and detergents too find their way into water sources. Many of these pollutants seep through the ground and contaminate groundwater as well. Modern technology in the form of tubewells has allowed us to extract more groundwater than can be replenished.

So we are faced with a situation where demand for this limited but vital resource is constantly increasing. But its availability is declining sharply because of overuse, misuse and wastage. Not only people, but all forms of plant and animal life are suffering. And if we do nothing, the amount of water of usable quality will become even less while demand for it will continue to go up.

What can we do to deal with this problem ? We can conserve water by learning to use it more wisely and effectively. And how can we do that ? By wasting less, by collecting more, by storing more efficiently, by not polluting and by recycling waste water. The following activities deal with these different aspects of water conservation.

8

Before We Begin

In most parts of our country, water is scarce. In many villages women walk several kilometres to collect a few pots of water for the family. Depending upon the size of the family and its requirements, and also on how far the water source is, they may have to make several trips a day.

Others have to walk only as far as the village well or the community tap or handpump. Still others may have a handpump or well in their own backyard. Some have piped water connections, especially in many urban areas. But just having a water source close by does not mean water is freely available. In many cities and towns in India water is available through these piped connections for only a few hours a day.

When water is scarce, people understand its value and do not waste it. But where water is a little more easily available, we tend to become careless -- in ways that we may not even be aware of. We sometimes throw away water that we had stored when we fill fresh water the next day. We do not get leaking taps fixed immediately. If we have access to piped water supply in our homes or at a standpost, we often let the water run while washing clothes or vessels.

The way we drink water may also be wasteful. We may drink from our cupped hands and allow some of the water to flow down through our fingers or down our forearms. We may pour water into our mouths or drink from a cup but we may throw away the water left over.

There are many steps we can take to reduce wastage. One of these is to check leakages. To take an example, if a household uses 150 litres of water per day and five litres is lost through leakages, 1825 litres can be saved in a year just by fixing the leak. If each household in a city of say ten lakh households can control leakages, a very large amount of water can be saved. (Also see case study titled 'Water Management in Sukhomajri.')

What We Can Do

8

Subject	Group size	Suitable time/season	Materials
Social Studies	Individual	Any time	Container of known volume, clock/watch.
Place	**Duration**		
Classroom	45 minutes		

Objective

To identify a local problem of water wastage and to try and find solutions.

Activity

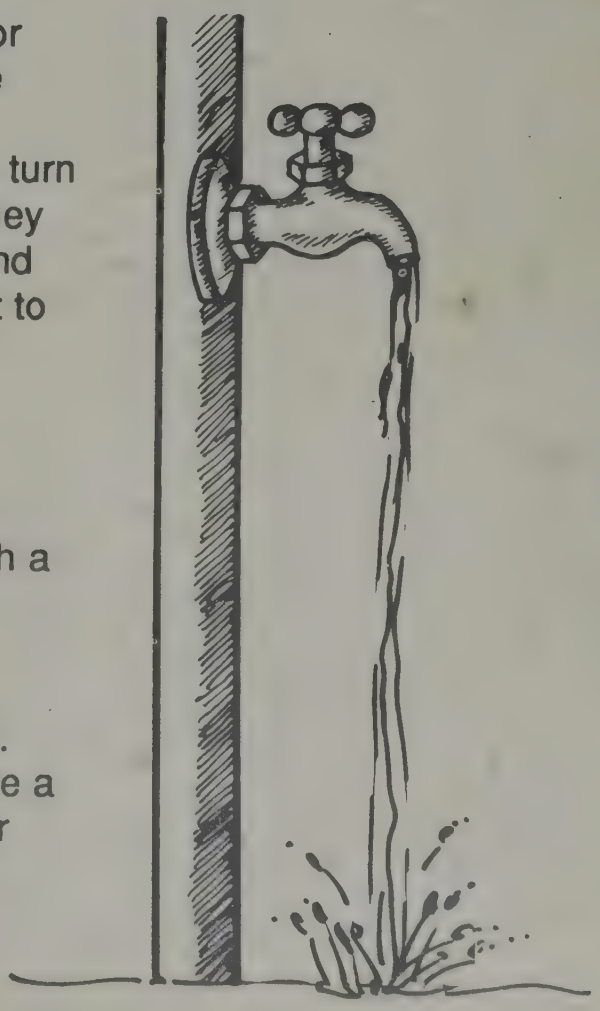
Ask students to carefully survey the school premises.

They should locate the sources and points of water supply, namely, taps or other arrangements for drinking water, taps in toilets, water supply in garden (if any) or any other source.

They should note down how water is being used and in what ways it is being wasted (the taps may be leaking or left open, or water may be collecting and stagnating at a particular point.)

Students can discuss and list out ways by which the wastage could be minimized or stopped. In case a water tap drips at home or in the school put a measuring jug under the tap. Find out how much water collects in it in ten minutes or find the time required to fill the water jug to a marked level. Calculate how much water is being wasted in 24 hours. Find out the number of taps that leak in the school and calculate the amount of water being wasted in the school in one day. Inform the school principal about the wastage of water.

If there is some action that students can take individually or collectively to tackle the problem, they should plan out the project. Some examples: They could put up posters at appropriate places in the school to encourage students to turn off taps or not to throw away water they do not drink. Or they could dig a channel from the point where water collects and divert it to a nearby drain or plant bed, so that it can be put to some use.



Extension/Variation

Students can undertake the same exercise at home or with a group of friends in the neighbourhood.

Enumerate some of the wasteful practices we indulge in (some examples are given in the background information). Ask students to observe how people waste water and make a list of these wasteful practices. Students should share their observations in class.

9

Before We Begin

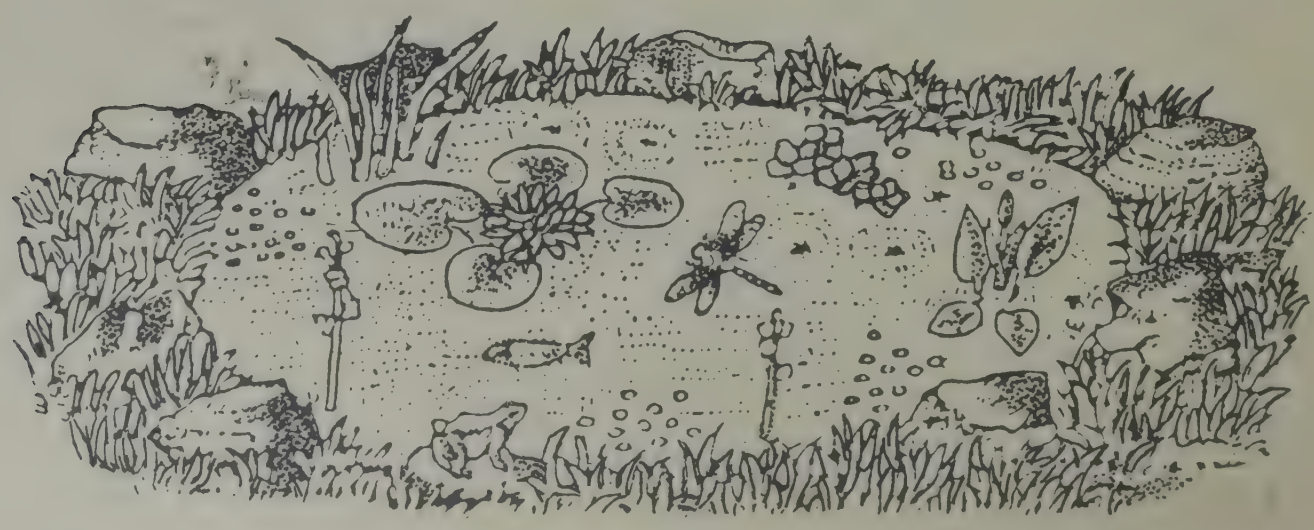
One way of conserving water is by preventing its wastage -- in our homes, schools, neighbourhoods and places of work. Another important way is to prevent wastage of rainwater.

Most of our fresh water is obtained from rainfall. Rain replenishes water in ponds, lakes, tanks and reservoirs, it runs off into rivers and streams and seeps into the ground and is stored as groundwater. Some of this groundwater seeps out of the earth to feed rivers and streams.

Nature provides one of the best ways of conserving rainwater -- and that is vegetation. Any vegetative cover, whether mere blades of grass or a big forest, helps to slow the water running off the land. This helps check soil erosion. The canopy of vegetation, by absorbing the impact of raindrops, minimizes the destructive effects of the beating action of rain on soil. Roots of plants hold the soil together and prevent it from being washed away. They also keep the soil porous thus helping rainwater percolate into the ground. The roots and stems filter the silt out of the run-off water, slow it down and take the erosive power out of it. Vegetative cover also provides decaying organic matter or humus which forms an additional protective layer over the soil. This layer reduces the impact of raindrops. It also absorbs water and allows it to seep through the soil to be stored as groundwater.

In recent years, we have been destroying this protective cover at a tremendous rate. We cut down forests for timber and agriculture. Our cities and towns are encroaching on agricultural land. Land without vegetation becomes hard. Rainwater can no longer percolate into the ground and so most of the water runs off into ponds, streams and rivers, carrying with it fertile top soil. Deposition of silt in water bodies reduces their ability to hold the increased volume of water. This causes floods as some water overflows the banks and the rest rushes away towards the sea. And all this causes enormous wastage of rainwater.

But if we protect our vegetative cover where it exists and revegetate lands that have lost it, we can prevent this wastage of rainwater. The following activity illustrates this fundamental principle of soil and water conservation.



Conserving Water in Nature

9

Subject
Social Studies/Craft

Place
Outdoors or class room

Group size
Entire class

Duration
Two weeks to prepare the vegetated tray
30 minutes for the activity

Suitable time/season
Any time

Materials
Two trays or cardboard or wooden boxes (approximately 90 cm x 50 cm x 15 cm), plastic sheet, piece of tin for spout, one tin can with a perforated base, brick pieces, pebbles, ordinary soil, manured soil, mustard or jowar seeds, two glass jars (one litre capacity), water.

Objective

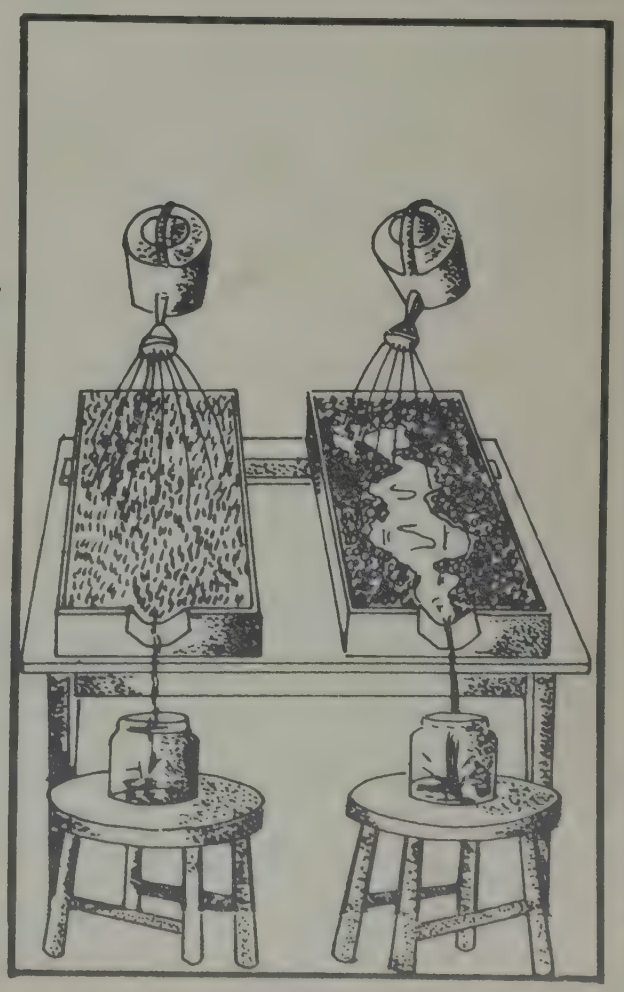
To understand the importance of vegetative cover in conserving water in nature.

Activity

Let the students take two cardboard or wooden boxes or trays approximately 90 cm x 50 cm x 15 cm. Line them with a plastic sheet to make them leakproof. These sheets can be made by cutting open old plastic bags and fusing the edges together with the help of a candle. At one end of each box cut a 'V' notch 10 cm deep and fit it with a tin spout to draw the run-off water into a glass jar (as shown in the illustration.)

Fill each box with 3 - 4 cm layer of brick pieces and pebbles, followed by 3 - 4 cm layer of ordinary soil, followed by 3 - 4 cm layer of manured soil. Sow mustard seeds or any other quick growing plant seeds in one box. Leave the other box bare. Sprinkle water on Box 1 regularly till the plants are 8 - 10 cm high.

Now set the boxes on a table so that the spouts extend over the edge. Place a brick or a stick under the other end to give them slope. Place empty glass jars on stools beneath the spouts (as shown in the illustration.)



Now let the students gently pour equal amounts of water over the two boxes. Let them check the rate of flow and collect the water that flows out from the two boxes in the glass jars. Let them note the difference in the quantity and quality of water collected in the two jars.

Evaluation

Why is the amount of water that flows out from the vegetated box less than that from the bare box ?
In which jar is the water more muddy?
How do plants help to conserve water ?
Why is it necessary to cover and protect the soil by natural means?

10 Before We Begin

In India, the total annual precipitation of 400 million hectare metres is enough to place the entire land surface under water to a depth of over one metre. But it is spread unevenly both in space and time. While Cherrapunji in the east receives 1140 cm of rain in a year, Jaisalmer in west Rajasthan receives only 21 cm. Over most of the country the entire rainfall for the year occurs during a three-month period, between mid-June and mid-September.

What we can do is to store water when it is available, for use later when it is scarce. Water can be stored either above ground in ponds, lakes or tanks, or underground as groundwater.

Although groundwater recharge and storage are essentially natural phenomena, we can play an effective role in controlling run-off and increasing percolation of rainwater. We hinder the process by destroying the vegetative cover on land; we can assist by protecting the vegetative cover, revegetating barren lands and by building percolation dams. The tradition of building percolation dams has been common in India, especially in parts of Maharashtra and Karnataka. These are small dams or bunds built on porous soil, often across the beds of seasonal streams or in small valleys. Rain or storm water thus collected seeps into the subsoil and into the underlying aquifer (water-bearing layer of rock). This water can be tapped by digging wells downstream from the dam.

How we store water is important. One problem with trying to store water in ponds or tanks dug in the ground is that, because of the porosity of the soil, water seeps out from the bottom and sides. It also evaporates from the open surface. To prevent seepage, the sides and bottom have to be lined with an impervious material such as cement or plastic sheets. An inexpensive technique of Russian origin involves lining ponds with a layer of animal dung which is covered with freshly cut grass, and banana or other leaves. This is topped with a layer of wet soil from a nearby pond which is allowed to dry for two to three weeks to make the pond leakproof.

Evaporation can be controlled by covering the water surface. That can be easily done when we store water in a pot. But when the surface is large this becomes difficult and expensive. Plastic sheets are often used as covers. Certain chemicals, when sprayed on the water, reduce evaporation. The amount of evaporation depends on the surface area of water. If we reduce this area, evaporation is also reduced. Evaporation from wells is therefore much less than from ponds.

The following activity introduces the concepts of seepage and evaporation control.

Water Storage

10

Subject	Duration	Suitable time/season	Materials
Social Studies	30 - 40 minutes for Part I	Part I -- any time	Shovel or hoe, old plastic bags, candle, 1 bucket of water, mug or cup, 8 - 10 stones.
Place	One day for Part II	Part II -- when it is not raining	
Outdoors			

Objective

To make students aware of the need for controlling seepage and evaporation for effective water storage.

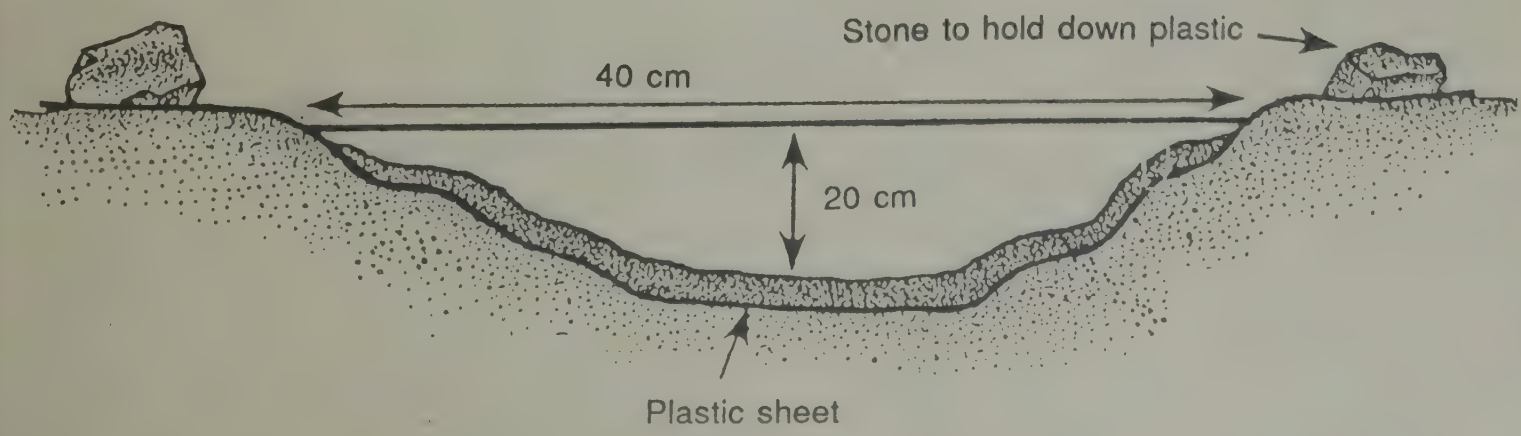
Activity

Part I

On dry ground, draw two 40 cm squares with the edge of the hoe. Ask students to dig two pits 20-25 cm deep in the outlined squares and cover the bottom of one pit with a 1.25 metres square plastic sheet (this can be made by cutting open old plastic bags and fusing together the edges over a candle). Make sure there are no holes in it. The sheet should be pressed down till it covers the bottom and sides of the pit.

Ask the students to place stones and pebbles on the edges of the sheet around the mouth of the pit to hold the plastic sheet in place. Now ask them to fill both pits with equal amounts of water (approximately 20 cups).

Ask students to check the level of water in the two pits as the water is being poured, after all the water has been poured, and five minutes after the water has been poured.



PIT LINED WITH PLASTIC

Evaluation

Ask students why the soil that they dig is more moist than the top soil.
What happened to the water poured into the unlined pit?
When there are natural depressions, what happens during rains?
What happens to the water after the rains?
What are the possible materials which can be used to line the pond?
What are the properties of an ideal liner? (Discuss some of the following materials -- cement, bricks, stones, large leaves sewn together, plastic sheets.)

Part II

With the cup, empty out all the water from the unlined pit. Ask students to line this pit with the second plastic sheet in exactly the same way as the other pit was lined. Now pour 20 cups of water into this pit. Let the students cover the mouth of the first pit with a plastic sheet, cardboard piece or a newspaper. Hold it in place by placing stones along the edges. Leave the other pit uncovered.

Let the students check the level of water in the two pits after 24 hours. They can check the water again the following day.

WATER STORED IN A CLOSED TANK

Evaluation

Why is the level of water in the covered pit higher than the level of water in the uncovered pit?
What can be done to prevent evaporation of water from a pond?

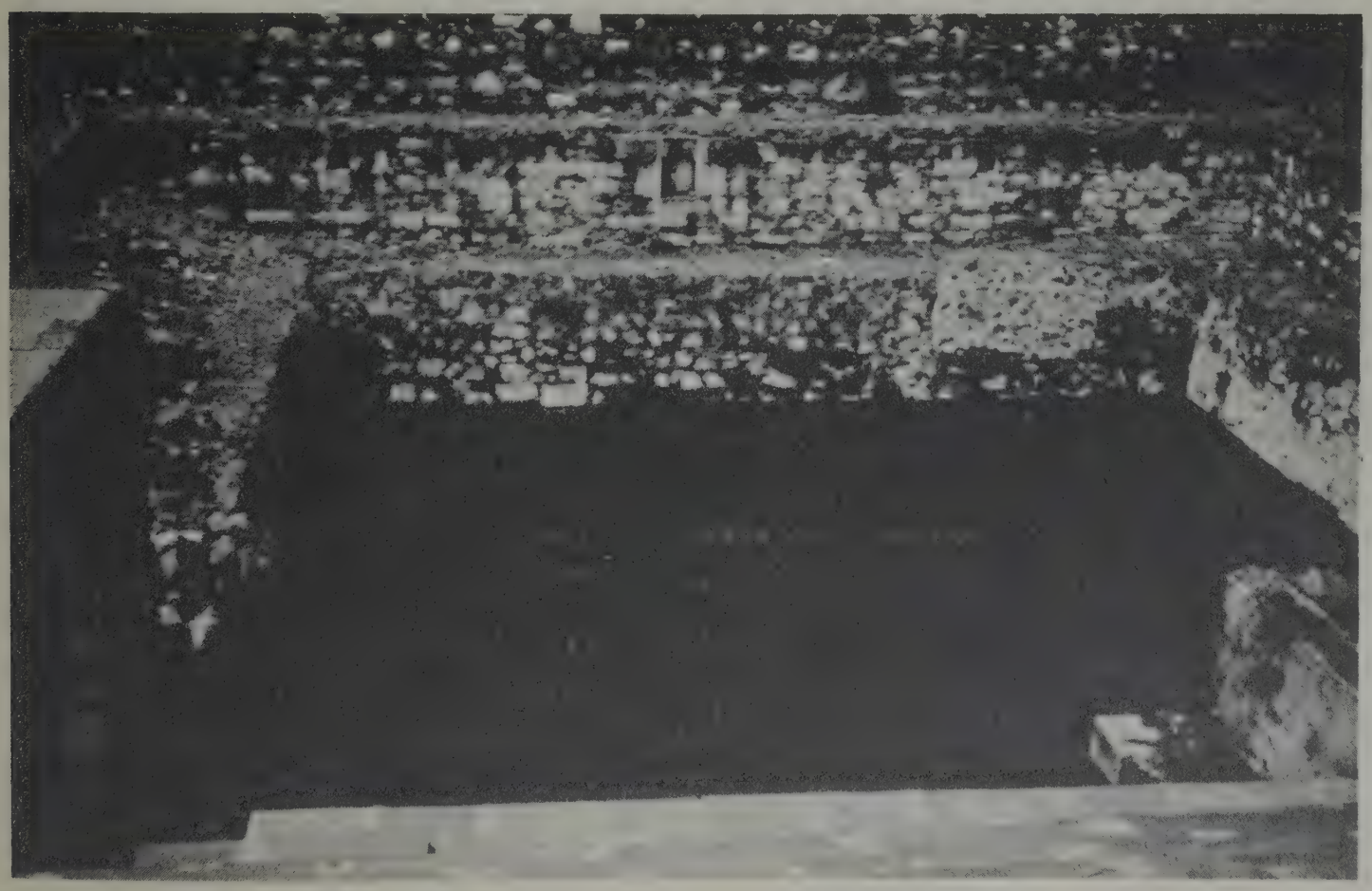
Extension/Variation

Divide the class into several groups. Each group of students should represent one region of the country. Each group should be asked to find out about the water storage practices in their region. Each group should draw and colour the water storage systems and domestic water containers used in their region, with a brief description about them.

The different water storage patterns in different regions of the country should be highlighted on a map of India and displayed in the classroom, entitled 'Our Water Sources and Storage Practices.'

They should be asked to observe the different water storage containers used in their friends', relatives' or neighbours' houses and find out if and why they differ.

WATER STORED IN AN OPEN TANK



11

Before We Begin

Agriculture is the major user of water. No matter how fertile the land, if there is no water, plants will surely die. This is because plants can absorb nutrients only when dissolved in water which their roots draw from the soil. When there is no water, plants die of hunger as well as thirst.

Where rainfall is not enough, agriculture has to depend on irrigation to provide the necessary amount of water for plant growth. But half the water used for irrigation is lost through evaporation and transpiration. By adopting better agricultural practices we can increase irrigation efficiency and thus conserve water.

Agricultural practices which use very little water and help conserve moisture in soil are called **dry farming techniques.** As plants draw food from the soil through their roots, techniques have been developed to supply as much water as possible to the roots without most of it being lost to deeper layers of the soil through seepage or to the atmosphere through evaporation. For example, **sprinkler irrigation** provides water in a spray which gradually moistens the soil. A further improvement is **drip irrigation**, which drips water directly near the root of the plant.

Mulching is a method of covering soil to prevent evaporation so that the soil retains moisture. The cover is provided by dry plant material such as straw, dried leaves and wheat stubble. Synthetic material such as plastic sheets can also be used.

Regular weeding also prevents the loss of moisture through transpiration by unwanted plants and retains water for use by the desired crop.

Some plants need a lot of water, some very little. Sugarcane, for example, needs plenty of water. Therefore, crops should be selected keeping in mind the availability of water.

An inexpensive variation of drip irrigation is presented in the following activity.

Better Agricultural Practices

11

Subject	Group size	Duration	Materials
Science	10 to 15 students depending upon the size of the class and the area available in the school compound for planting the trees.	Planting -- one hour Monitoring -- four to ten months	Shovel or hoe, earthen pitcher, lid for pitcher, large nail, measuring cup.
Place		**Suitable time/season**	
Outdoors		Preferably the rainy season	

Objective

To demonstrate the effectiveness of dry farming techniques through pitcher irrigation.

Activity

Divide the class into three or four groups. Contact the nearest forest department office and get 6 - 8 saplings of a fast growing tree species such as Subabul, Surjana (drumstick) or Neem. The saplings should be 60 - 90 cm high.

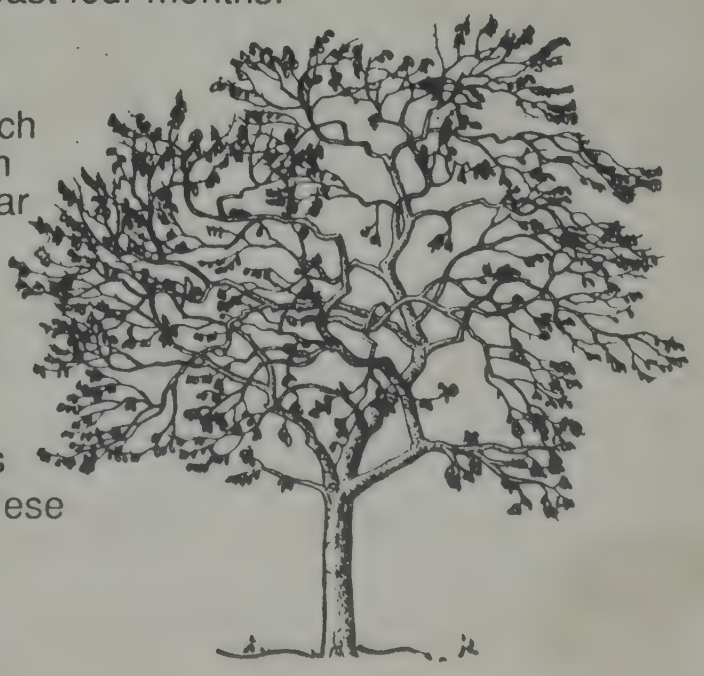
Give each group two saplings. Ask each group to dig two pits measuring 45 cm x 45 cm x 45 cm. These pits should be at least one metre apart. Let them fill half of each pit with the dug-up soil, hold a sapling in the middle of the pit and fill it with the remaining soil, pressing it down to hold the sapling firmly. Students should take care not to damage the roots while planting the sapling.

About 25-30 cm from the base of one of the two saplings planted, ask each group to dig a pit large enough to hold a pitcher. Let them punch a few holes in the base and one side of the pitcher by gently tapping a nail into it. Now ask them to bury the pitcher so that only its mouth remains above the ground. The punched side of the pitcher should face the plant. The pitcher should be filled with water and its mouth covered with a lid.

Of the two saplings planted by each group, the one with the pitcher should be watered only by filling the pitcher once a week. The other one should be watered directly once a week. Let each group measure and note the amount of water used for watering the first sapling once a week. They should also note the amount of water needed to fill the pitcher to its rim every week. Let the students monitor the growth of the two sets of trees for at least four months.

Extension/Variation

Ask the students to locate a tree in the neighbourhood which seems to be drying up. Let them bury a pitcher or drum with small holes next to it. Let them water the container at regular intervals and observe what happens to the tree.



Evaluation

Which of the saplings is growing the best?
If there are differences in the rates of growth of the saplings grown by different groups, what could be the reasons for these differences?
How does the pitcher provide water to the plant?
Why is the pitcher buried in the root zone of the plant?

12

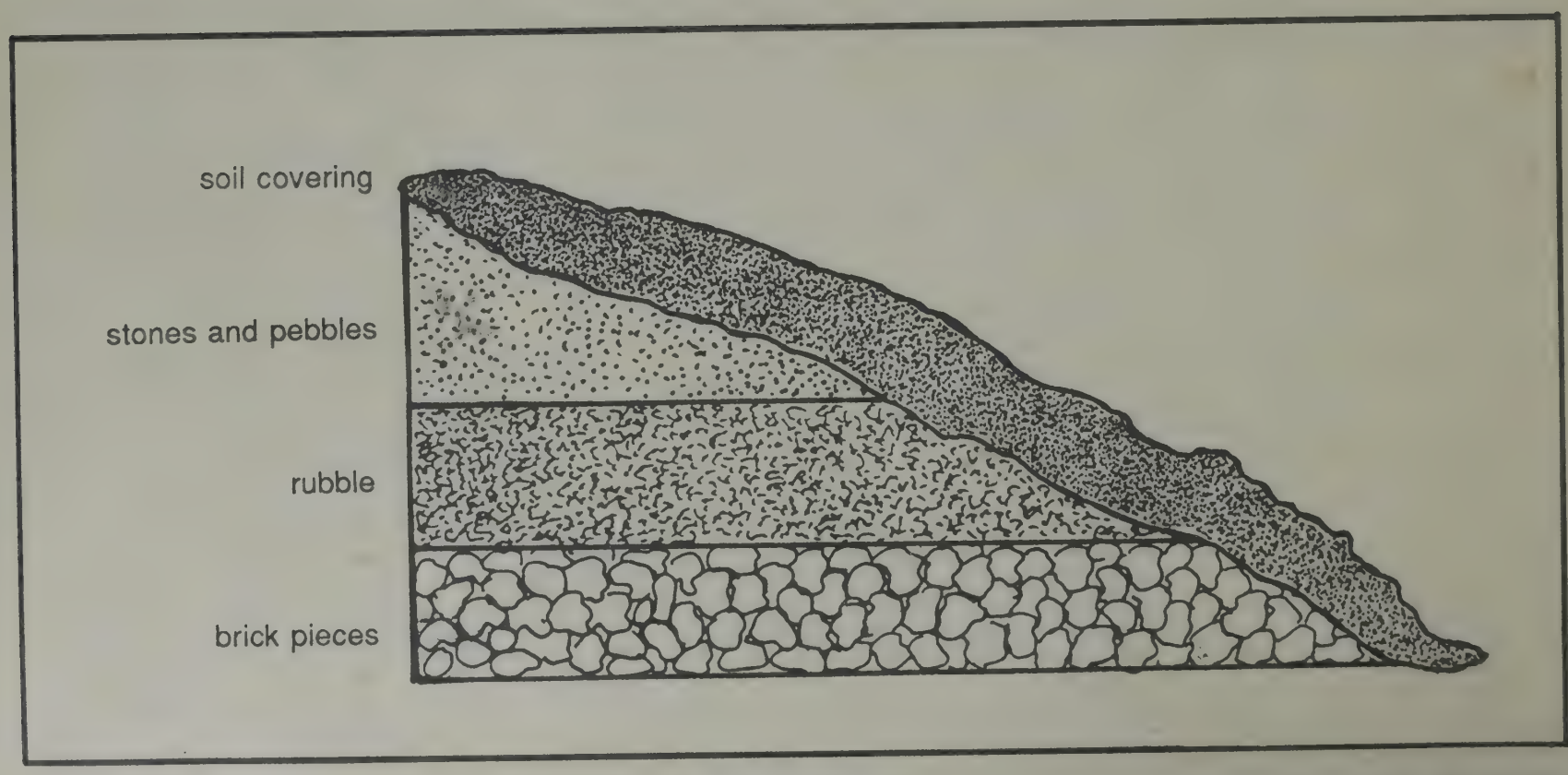
Before We Begin

Farming on sloping land is quite common. But slopes pose many problems. During rains, water flows off the slopes very fast and carries off the fertile topsoil with it. Some slopes are so steep that cultivation is very difficult. Without proper techniques, farming on hillsides can have disastrous consequences. But these problems can be overcome by simple methods of slowing the speed of water as it moves down hillsides and giving it a chance to soak in over a wide area. **Contour farming** is one such technique. Fields are ploughed and crops are planted across the slope. This checks the water from rushing down the slope. (A contour is an imaginary line joining points at equal elevation.)

Strip cropping, another practice, involves planting strips or bands of crops along the contour. Strips of close and quick-growing plants such as fodder grasses are planted next to row crops such as maize.

A third method is **terracing**. The sloping surface is converted into a series of wide, flat steps, one above the other, along the slope. From a distance the terraces look like a staircase up the hill. The edges of the terraces are supported by stone walls. Crops are planted on the flat surface of each terrace. Such farming practices slow down the flow of the run-off water and help it percolate into the soil and recharge aquifers.

In the following activity students prepare a terraced slope in a tray of soil and grow plants on it.



12

Retaining Water on Slopes

Subject	Duration	Materials
Social Studies/ Science	Two weeks to prepare the model and 30 minutes for the activity	Two trays or cardboard or wooden boxes (approximately 90 cm x 50 cm x 15 cm), plastic sheet, piece of tin for spout, one tin can with a perforated base, brick pieces, pebbles, ordinary soil, manured soil, mustard or jowar seeds, two glass jars, (one litre capacity), water.
Place		
Outdoors/ classroom		
Group size	**Suitable time**	
Entire class	Any time	

Objective

To demonstrate that terracing can help in conserving water on sloping lands.

Activity

Let the students use the same model as in the activity on "Conservation in Nature" (Activity 9). In one box, furrow the soil and make three or four terraces at equal distances and heights as on a contoured terraced slope. The soil at the edge of each step is raised slightly and strengthened with small stones and twigs or straw.

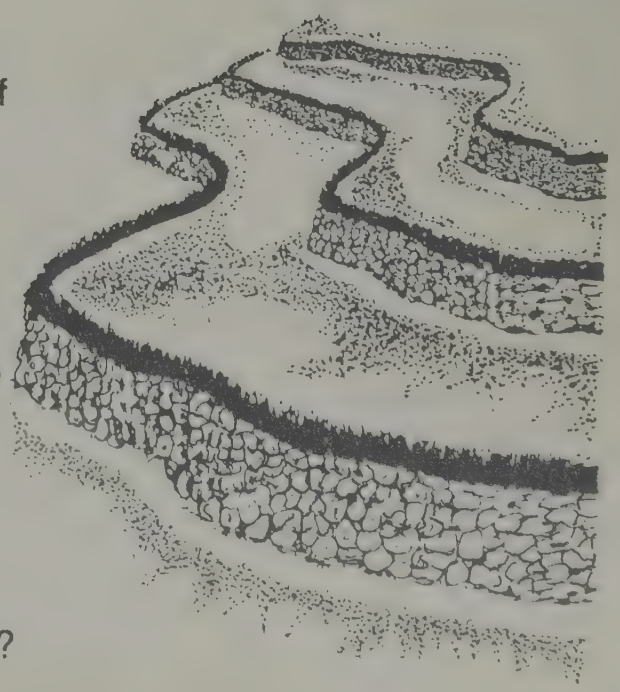
Let the students sow mustard seeds, jowar seeds (sorghum), or seeds of any other fast-growing plant on the terraces. Water the plants till they are 8 - 10 cm high.

Let the students set the two trays on a table as in the previous activity. Place empty glass jars on stools beneath the spouts (as illustrated). Now sprinkle equal amounts of water over the two trays. Ask the students to check the rate of flow and compare how much water flows out from the two trays.

They should note the differences in the quantity and quality of water collected in the two jars.

EDGE OF TERRACE

TERRACED FARMING



Evaluation

Why is the amount of water that flows out from the vegetated tray less than the amount of water that flows out from the bare tray ?
Is there a difference in the quality of water that flows out from the two trays?
How does contour terracing and terrace farming help to conserve rain water ?
What are the natural methods of conserving water on slopes ?

13

Before We Begin

Human beings use water in a variety of ways -- drinking, washing, cooking, irrigation, industrial production, generating electricity and a host of others. Each of these uses produces wastes in some form. Soaps and detergents, food particles, grease, industrial wastes, fertilizers and pesticides, and germs from human or animal sources all contribute to the pollution of water. Such water is usually disposed of into water bodies. Water from these sources is subsequently put to further use.

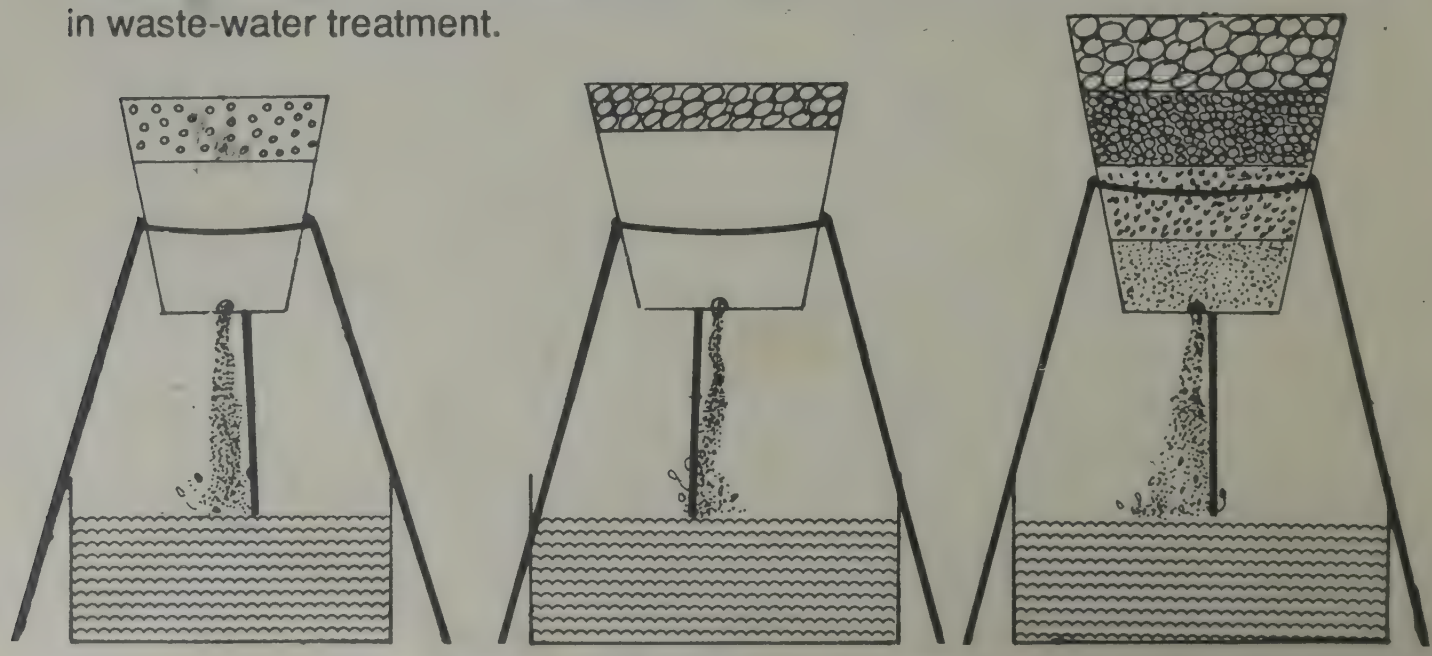
The quality of water required for different uses is different. For drinking we need water that is unpolluted and free from bacteria. For washing and cleaning, the water need not be as clean as drinking water. Water once used can be reused for different purposes either directly or after treatment.

For example, waste-water from the kitchen (when detergents are not used) may be diverted to the kitchen garden. Water containing soap or detergent may be passed through a sand pit to filter out these pollutants.

Treating waste-water to remove its harmful ingredients before it is reused or disposed of helps in conserving our precious water resources. Domestic and industrial waste-water is increasingly being purified for reuse in large urban areas. Networks of sewers carry the waste water to sewage treatment plants. However, in most villages and small towns in India the old system of waste disposal still exists where human excreta is disposed of manually. Waste-water from houses is carried through open drains to nearby fields or streams, or is poured into pits.

At sewage treatment plants the waste-water, which is partly liquid and partly solid, is fed to sedimentation tanks full of water. An extremely slow flow is maintained so that the impurities gradually sink to the bottom. Fresh water can then be drawn of the surface and, after passing through a filter, safely discharged into a stream or river. (The case study 'Water Treatment Process in Akividu' describes a water treatment plant in detail.)

In the following activity students learn about some of the processes involved in waste-water treatment.



Waste-Water Treatment

13

Subject	Duration	Materials
Social Studies / Science	30 minutes	Three earthenware flowerpots, sieve or wire or mesh with large holes, sieve or wire mesh with small holes, bucket, a tripod stand for the flowerpots, some gravel, pebbles, coarse sand and fine sand, a vessel.
Place	**Suitable time/season**	
Outdoors	Any time	
Group size		
Entire class		

Objective

To understand one of the processes involved in treating domestic waste-water.

Activity

Let the students take three flowerpots and place a sieve/wire mesh with large holes over the first pot and the sieve/wire mesh with smaller holes over the second pot. Ask them to put layers of gravel, pebbles and sand into the third flowerpot. (See illustration.)

Ask the students to take a bucket with some water and add mud, paper pieces, fallen leaves, sand, plastic and bits of cloth to it. Now let the students place the first flowerpot in the stand and place a vessel under it. Let them pour the water through the first filter and collect the water in the vessel. Let them examine the water and note down which of the added solids are still present. The collected water should be passed through the second pot and the procedure repeated. Water collected from this step should be passed through the third pot.

Extension/Variation

The students could visit a waste-water treatment plant and observe the various stages of treatment.

Evaluation

What are the materials that flow along with the waste-water from different sources in the house (i.e. from bathrooms, wash basins, kitchen, etc.)?
Are there any outlet covers (a small sieve-like cover) present in the waste-water disposal areas in your house?
What is the importance of having these outlet covers?
How does waste-water get treated and cleaned by natural processes?
How can waste-water be reused?
What is the waste-water disposal system in your city, town or village?

14

Before We Begin

All the water that has ever been available to our planet is on or in the Earth right now. We have already seen how little fresh water there is and how necessary it is to conserve it. Yet each day this vital resource is being polluted.

'Clean water', 'pure water', 'clear water' are some of the terms we use in describing water of good quality. But what do they mean? Pure water, two parts hydrogen and one part oxygen (H_2O), is great in the laboratory but not for plants and animals. Potable water also contains minerals such as magnesium, calcium, iron, and dissolved gases. However, an excess of these or the presence of other substances can pollute water. Water polluted by toxic materials can become a major health hazard.

In nature, water is never pure. Rainfall picks up dust, smoke particles, gases, bacteria and wastes from households, factories and industries. As the water runs along the surface of the ground or soaks into the earth it collects other materials from rocks and soil. Some materials are filtered out, others remain and are carried along with the water.

Many things that people do cause pollution. There is no way to avoid this entirely. When fuels are burned, they produce smoke and gases of various kinds. Ashes and other residues from the burning process can also contaminate water supplies. Household and industrial wastes, pesticides and fertilizers, and sewage are also sources of water pollution. So are surface mining and construction practices.

Fish, plants and other organisms that live in water cannot survive without dissolved oxygen. But when water gets polluted, most of the dissolved oxygen is used in the decay of the wastes in the water. Thus, as the pollutants in water increase, dissolved oxygen decreases and this reduces plant and animal life in water. (Also see case study 'Cleaning the Ganga.')

The following activity could be done in four phases. First, water from various sources is collected and some physical properties studied. These results help check the quality of water. Next, water from various sources is compared. Possible uses of water of different qualities are identified. For instance, the water we drink should be different from the water that may be used for irrigation or for flushing the toilets. Ideally, the quality of water should match the use it is put to. Thirdly, the students observe plants and animals living in and around a water source. They try to correlate the quality of water from the source to the kind of life it supports. Lastly, the students try to find out the approximate number of people using the water source and the kind of waterborne diseases prevalent in the community.

Is Water H_2O?

14

Subject	Duration	Materials
Social Studies / Science	Approximately one week	10 - 12 containers of approximately one litre capacity for collecting water, 3 - 4 sheets of white paper, piece of white muslin, blue and red litmus papers, handful of soap powder, five glass beakers, a burner or stove
Place	**Suitable time/season**	
Outdoors	Any time	
Group size		
9 - 10		

Objectives

Through simple experiments, students will learn

1. whether water from different sources differs in quality.
2. to match differences in quality of water with appropriate levels of use
3. to correlate the quality of water to the kind of plant and animal life that the water source supports.

Activity

Phase 1

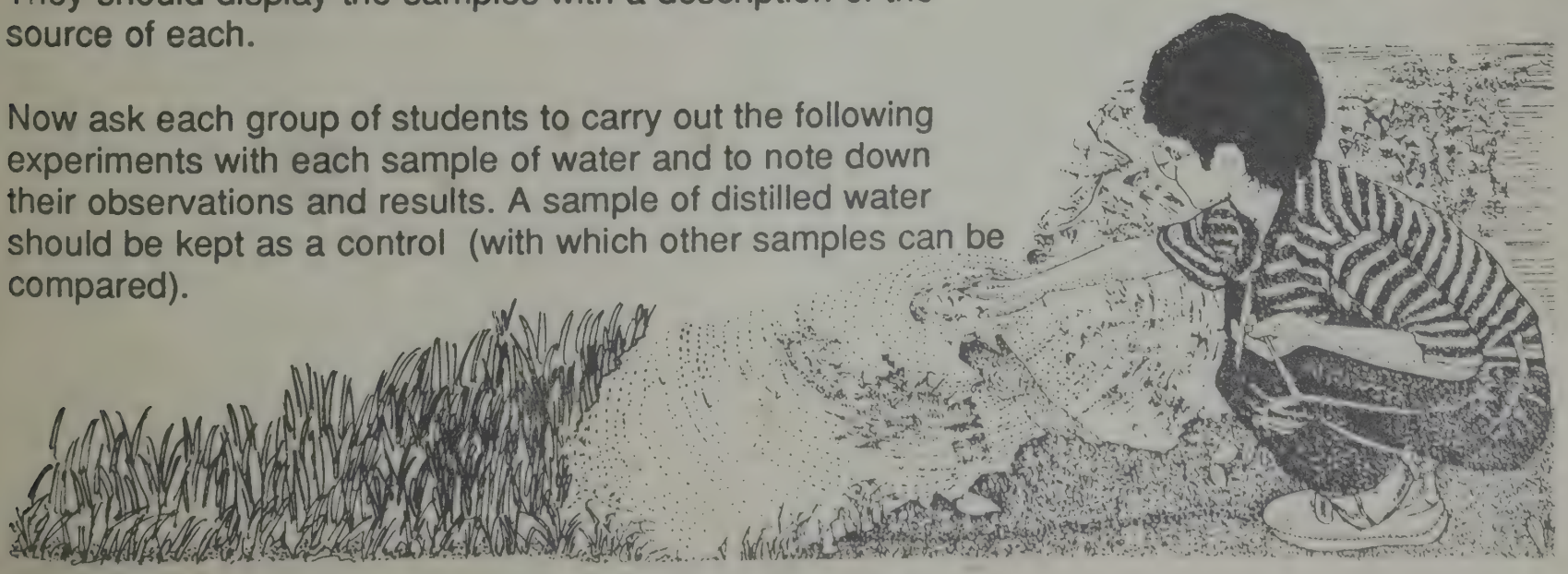
Divide the class into several groups. Let the students collect water from different water sources. Some examples are,

Rainwater	Water from the sea
Tapwater	Water from a stagnant pond
Water from a stream	Water from a river in the city
Water from a well	Water from a river in the countryside

All the samples should be collected on the same day. Each sample should be accompanied by a brief description of the source from which it was taken. Students should collect each sample in a separate, transparent container and label it.

Let the students bring the water samples to the classroom. They should display the samples with a description of the source of each.

Now ask each group of students to carry out the following experiments with each sample of water and to note down their observations and results. A sample of distilled water should be kept as a control (with which other samples can be compared).



1. **Colour**: The students should observe the colour of the water in the transparent container against a white background.

2. **Odour**: Does the water smell pungent, of rotten eggs, of rotten or decaying vegetables, or is it odourless?

3. **Turbidity:** The water should be observed against a white background to see whether it is clear or not.

4. **Presence of suspended solid particles:** Let the students filter the water through a clean white muslin cloth to check for any residue left on the cloth.

5. **Presence of dissolved particles:** Let the students evaporate 100 ml to 250 ml of water in a clean, transparent container to check for any residue left behind in the container.

6. **Acidic, alkaline or neutral:** Let the students use litmus paper to check whether the water is acidic, alkaline or neutral. A change in the colour of the litmus paper from red to blue indicates alkalinity; from blue to red indicates acidity; absence of change in colour indicates that the water sample is neutral.

7. **Presence of dissolved air in the water:** Let the students warm 100 to 250 ml of water in a clean transparent container. The water should be warmed below its boiling point to check for the presence of dissolved air bubbles adhering to the sides of the contaner.

8. **Hard or soft water:** Let the students take about 100 ml of water and put some soap powder into it. Let them observe and see if it gives lather easily with soap. If it does then the water is soft.

Source	Odour	Colour	Turbidity	Solid particles present	Dissolved particles present	Acidic/ alkaline/ neutral	Dissolved air present	Hard or soft

Phase 2
Now, let the students compare their observations and results obtained from the experiments with various samples of water. Based on this, ask the students to differentiate between the different types of water collected from various sources.

Now ask the students to briefly describe the quality of the water from the various sources and the possible uses of each quality of water.

Source	Water quality	Uses
1.Distilled water	Pure water	Used in industrial chemical processes.
2.Tap water	Clear water	Domestic purposes.
3.		

Phase 3
Groups of students should be asked to carefully observe plants and animals that live around different water sources. There may be some plants and animals living in the water. They could use a magnifying glass to observe and identify some of the eggs, larvae, algae or micro-organisms found in the water. Let the students correlate the quality of the water from each water source to the kind of plant and animal life it supports.

Phase 4
If possible let the students find out from Public Health Centres, the approximate number of people using a particular water source and the kind of water-borne diseases prevalent in that locality.

Extension/Variation

The students could be taken to a local water source such as a lake or a river. They could describe the water source, the life around the water source, the activities around the water source, the various uses of the water from the source and the kinds of pollutants that affect the source.

Evaluation

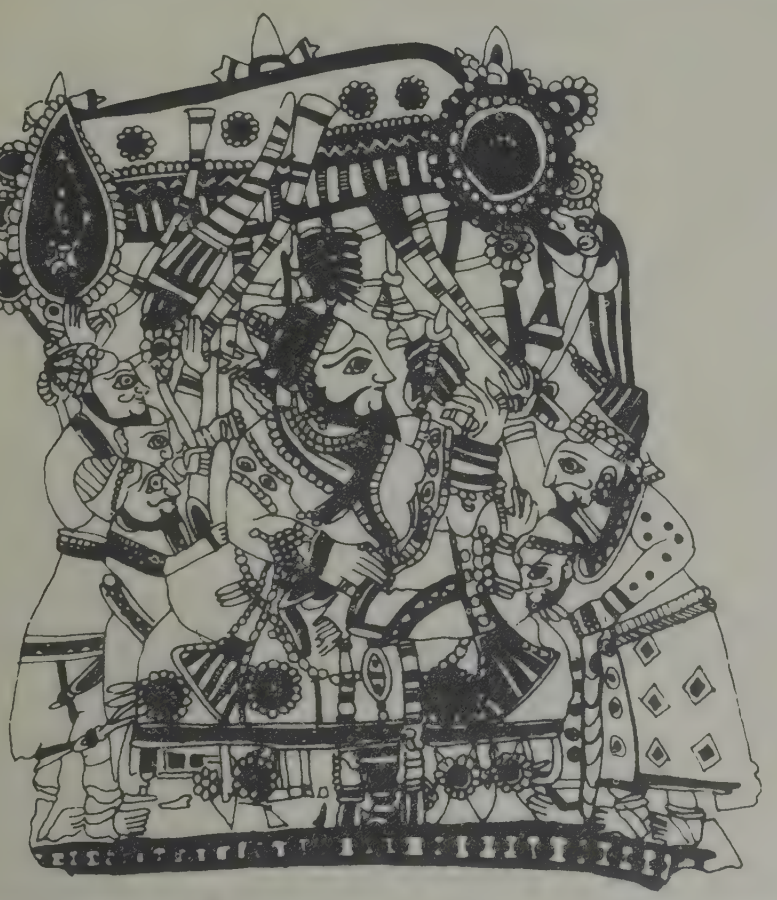
Why is there a difference in the quality of water from different sources?
Let the students associate the uses of water to the quality of the available water.
How can we conserve water by linking the uses of water to the quality of the available water?

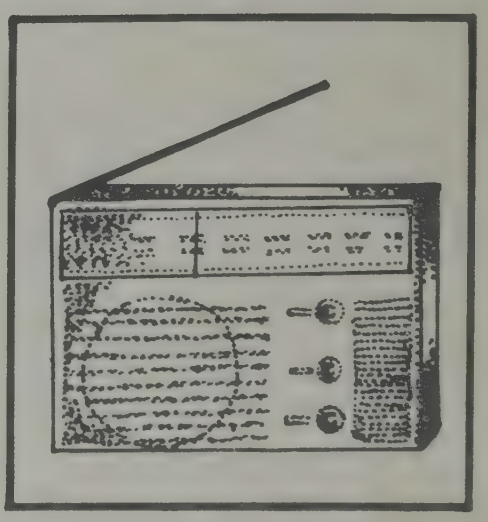
STAGNATING WATER CAN BE A HEALTH HAZARD

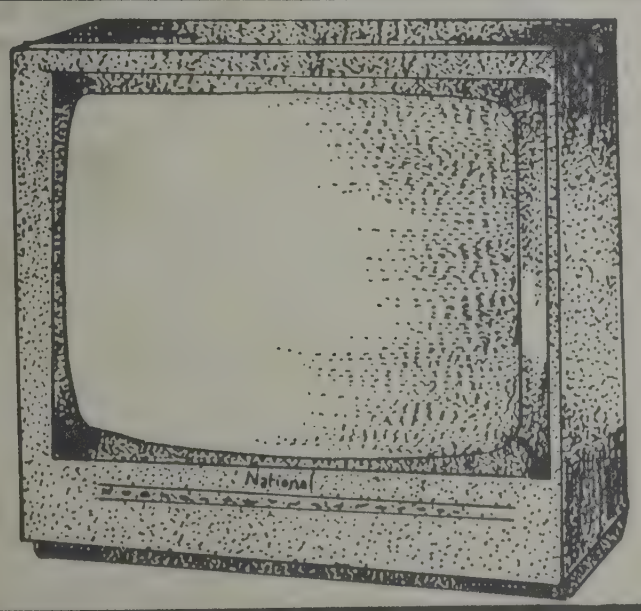
Spreading the Word - Overview

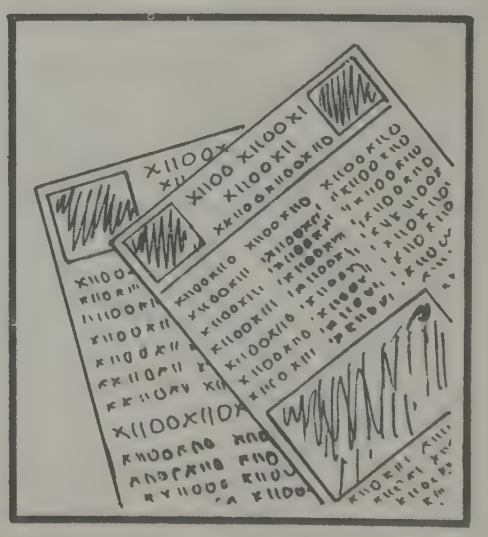
Water conservation is essential and urgent. For this several steps can be taken -- at both the individual and community levels. But if these steps are to be taken, large sections of people need to be made aware of the issues involved.

Interpersonal communications are one way of creating awareness. But there are many other media that can be used. Newspaper, puppet show, song, dance, radio, television, story, drama -- all these can be used for communicating a message. Students can explore ways of making their school, families and the general community aware of the need to conserve water and how this can be done.









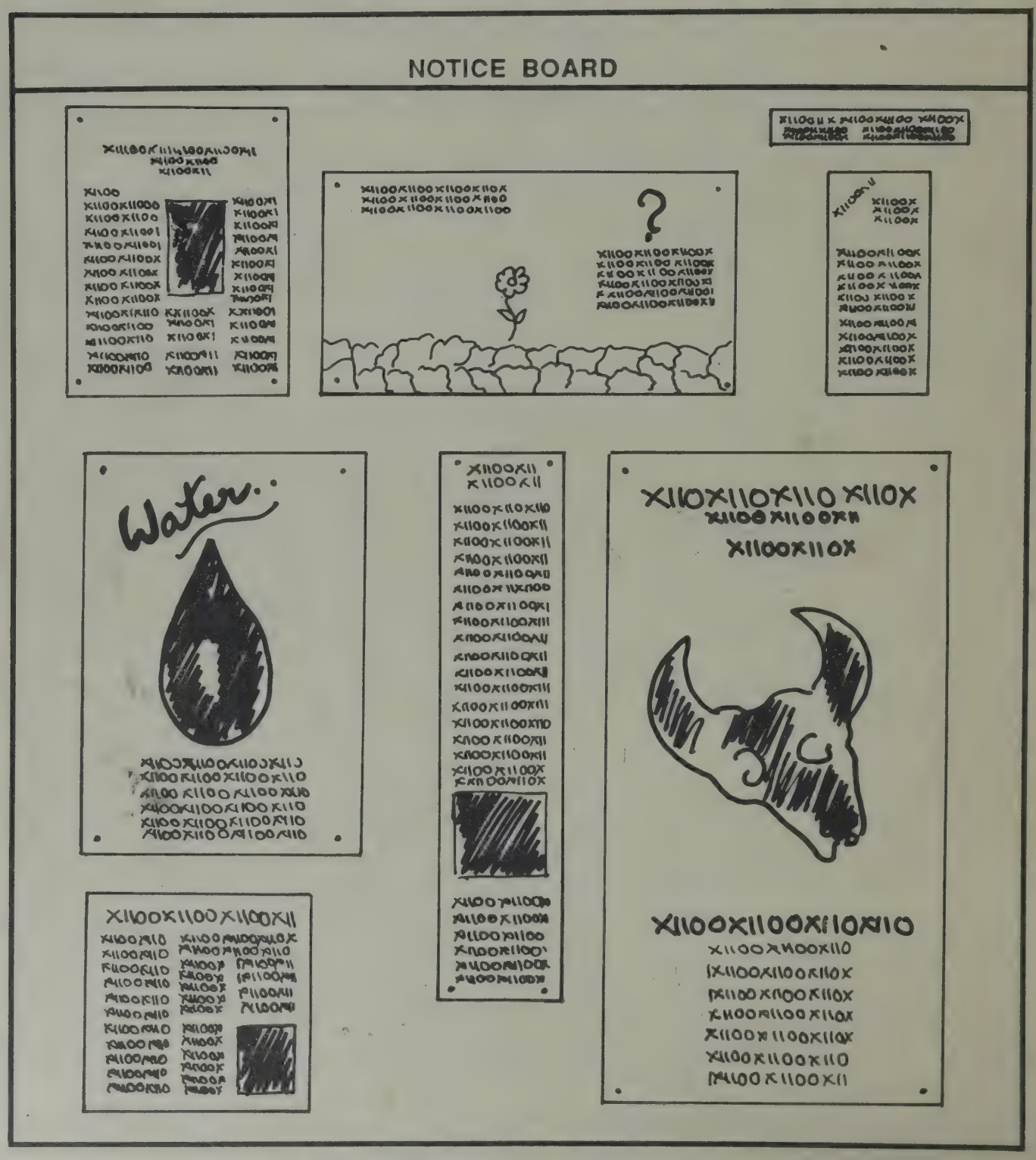
15

Before We Begin

A newspaper reflects much of what goes on around us. But most of us read only those items that are of some interest to us, while other issues -- important or otherwise -- are ignored.

In recent times, the growing concern for environmental issues has been reflected in newspapers too. More articles, news items and editorials, focus on various environment-related concerns. Such items help increase general awareness about these issues.

In the following activity, students could identify news related to water conservation, uses and wastage of water, traditional and modern ways of storing water, water pollution, floods, drought, and epidemics. These could be highlighted in a classroom situation or through essays, debates or posters.



Spot the News

15

Subject	Place	Duration	Materials
Language	Class room and home	Variable	Old news-papers and magazines, chart paper, scissors.
		Suitable time/season	
		Any time	

Objective

To make students aware of how newspapers and magazines highlight and discuss the issue of water conservation.

Activity

Ask students to read daily newspapers and mark out articles, news items and photographs on water conservation, water shortage, water wastage or other water-related issues.

After everyone at home has finished reading the paper, they should clip these items and bring them to the class the following day. Students can also collect news items from old newspapers.

These clippings should be put together at the end of the week and a large collage made from them. The clippings can be stuck on a cardboard or chart paper. Names of the newspapers from which the clippings have been taken and the date should be written next to each clipping.

Those news items or articles which relate to the local conditions or issues should be highlighted. Students can also highlight measures for conservation which they find most appealing. These issues could also be announced during school assemblies.

The collage should be put where the whole school can see it. Use this collage to start a discussion on water conservation or the role of the press in creating awareness about water conservation among the public.

Variation/Extension

Students can individually or in groups design posters or newspaper advertisements which highlight the need for or methods of water conservation.
Students can be asked to make short presentations on the basis of their posters or the newspaper clippings.
Students could also be encouraged to write on local issues of water conservation in the 'Letters to the Editor' column.

Evaluation

Ask the students to make a list of issues and aspects on water shortage, conservation or water wastage that they have learnt from the clippings.

16

Before We Begin

Stories have a universal appeal and have been passed through word of mouth across countries and down ages. And stories are an effective way of driving home a point. The Panchatantra stories, Aesop's fables and many folk-tales have a moral or lesson which is easily accepted because it is communicated in the form of a story.

Presented below is a story on the importance of water.

The Wise Water

Once upon a time there was perfect harmony in the forest. There dwelt together animals, birds and trees, merrily speaking the language of humans. Occasionally the Neem and the Banyan trees quarrelled. One morning as the forest awoke to a bright new day, two angry voices of the trees pierced through the dawn. A baby squirrel was the unintentional cause of this quarrel.

The squirrel lived in the Banyan tree. In a playful mood it ran up the Neem tree. Seizing this opportunity, the Neem tree teased the Banyan tree. Calling aloud, it said : "Who wants to stay with someone who occupies so much space?" The Banyan tree retorted : "I am considered to be the best among trees, with good reasons. My vines and branches are home to hundreds of birds and animals. They provide shade to tired travellers. Animals and birds feed on my leaves and fruits. My leaves are used for religious ceremonies. When you were born I was already 170 years old. What do you know about the world at 50 years of age?

The Neem tree said, "With due respect to you as an elder. But you should not take pride in your remarkable age. I have accomplished in 50 years what you took 170 years to do. Animals and birds live in my branches too, and they provide shade to man and beast alike. Most important, I serve the sick. My leaves and twigs are used for making herbal medicines. Although you are my senior, I am more useful than you".

A frog from the nearby river was listening to their argument. Hopping out he bowed to both the trees. "What are you both quarrelling about? In your own capacities, both of you are useful. The question who is important does not arise. I am sure you are aware that without water neither you nor I would have existed. And yet, the wise water never boasts about its manifold uses."

Both trees understood what the frog meant -- that without water no life was possible. They felt deeply ashamed and resolved not to get into petty fights again.

Story translated from Hindi by Durga Patankar

Story Time

16

Subject	Place	Duration	Materials
Language	Class room	30 minutes	Writing materials

Suitable time/season
Any time

Objective

To write stories on issues related to water conservation.

Activity

A student may read out the story given in the background. After this, read the opening paragraph of stories given below. Ask students to suggest solutions to the problem posed in each story. Alternatively, you may ask each student to complete the story by writing what he or she thinks should happen next.

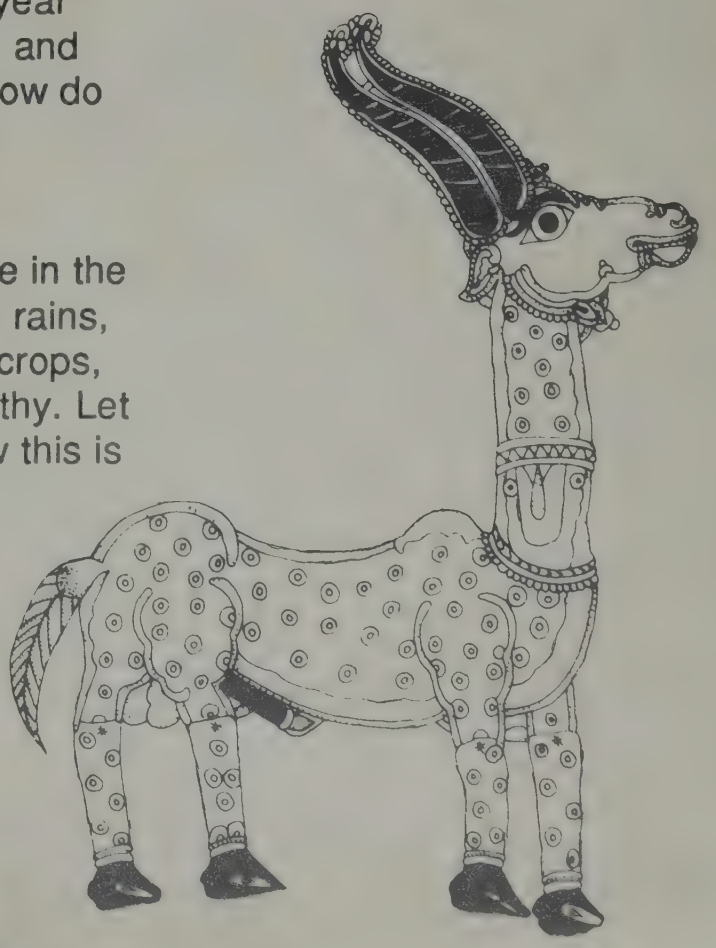
Story 1

"Once upon a time, in a land far away, there lived a king. He was a good king and ruled over his subjects justly and kindly. The people were happy and prosperous. But then one year drought struck. The rains did not come -- there was no water to drink, no water for cattle, no water to grow crops with. The king was very worried. He called his minister and said, "We will be able to manage this year because there is grain in the granary and the lakes and tanks have some water from last year's rains. But how do we ensure that even if we have a drought in future, activities can go on as normal?"

The minister replied "I have heard that there is a village in the southern tip of our kingdom which has not received rains, but is still green. They have been able to sow their crops, people have enough drinking water, cattle are healthy. Let us call the headman of this village and ask him how this is so.'

The king agreed.....

Ask the students to continue the story describing what measures the village leader suggested.



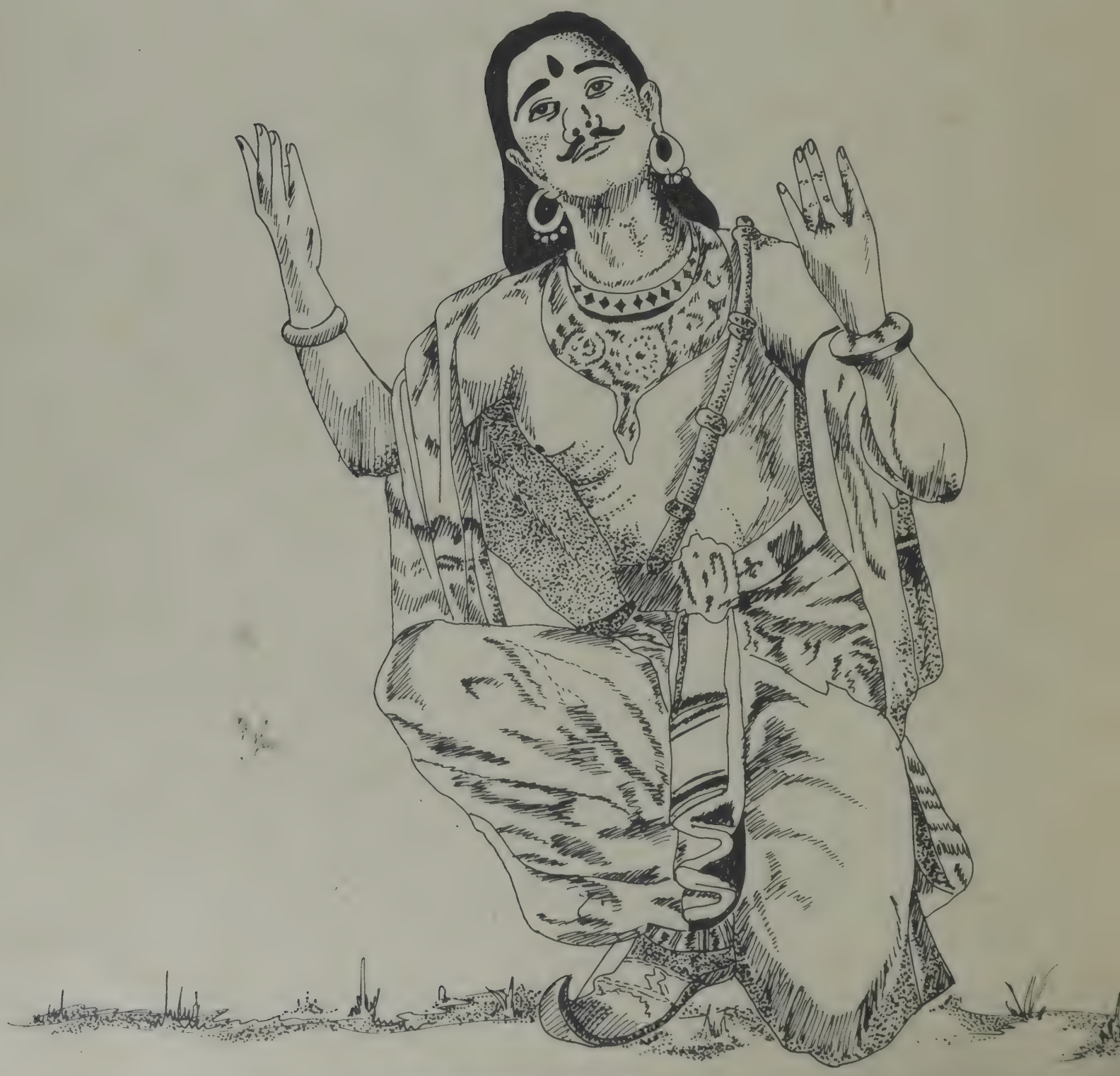
16 contd.

Story 2

"It was the weekly meeting of 'The Clue Hunters' -- a club of four young detectives. "What are the new cases for investigation this week?" asked the leader.

"Our local newspapers are reporting that the pond at the end of the town is turning red. Cattle which drink water from it are falling seriously ill. I think we must investigate who and what is leading to this pollution, and how it can be stopped. Some local industry is suspected, but no one is sure. "

The club members agreed that it was indeed important to investigate this...."



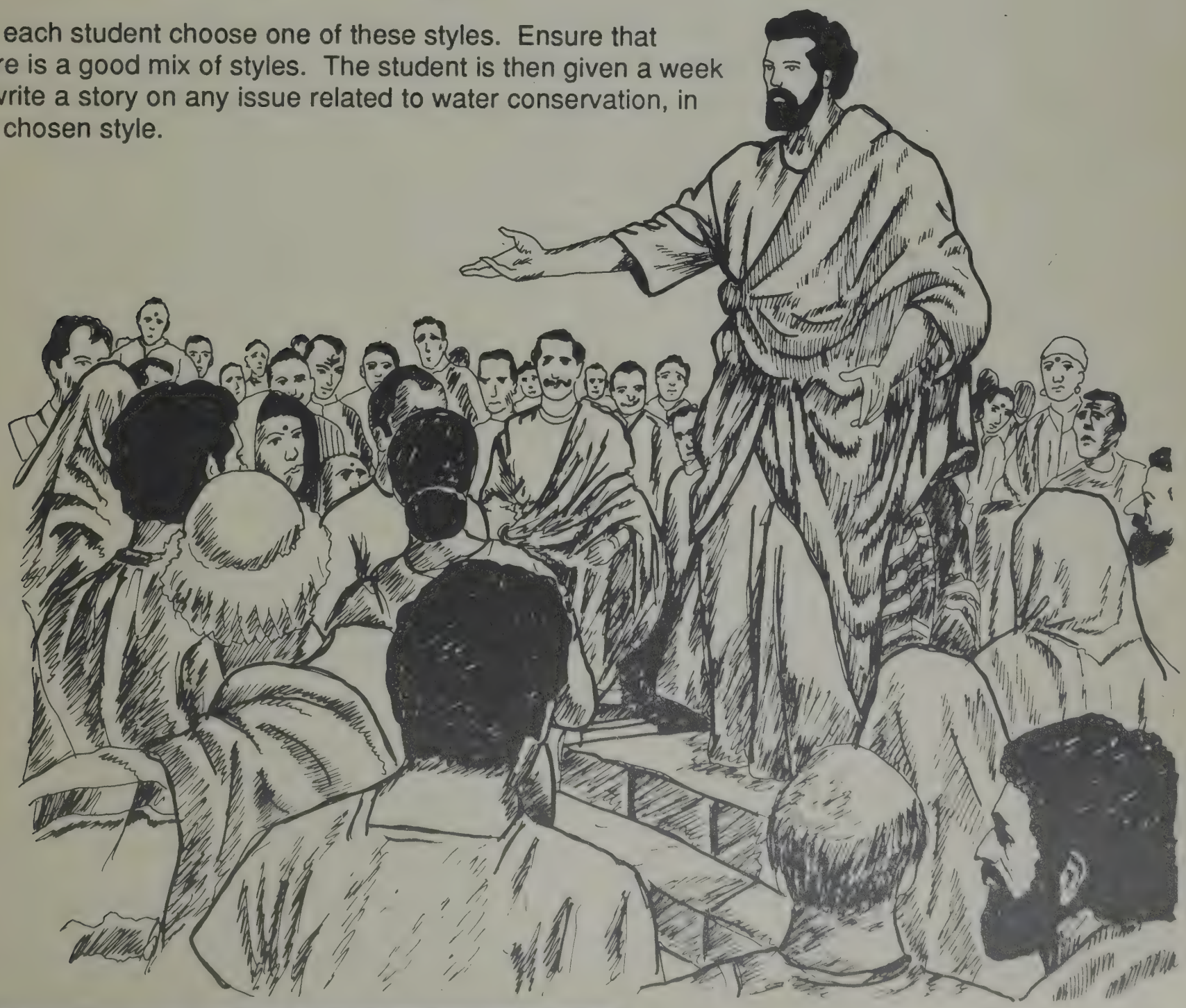
Ask the students to continue the story describing how they traced the culprits, how the water was cleaned and how future pollution was stopped.

Choose the three best stories and send them to a childrens' magazine, local newspaper or school magazine. Some of the shorter stories should be put up on the notice boards in the school. Other stories may be stitched together and circulated to other classes in the schools.

Variation/Extension

Discuss some of the stories the children have read and classify them into categories, for example, fairy tales, adventure stories, science fiction stories, stories of kings and queens, animal stories, detective stories.

Let each student choose one of these styles. Ensure that there is a good mix of styles. The student is then given a week to write a story on any issue related to water conservation, in the chosen style.



Case Study

Indus Valley

More than 4,000 years ago there flourished in the north-western part of the South Asian subcontinent a civilization known as the Indus Civilization. It extended 1600 km from east to west, and 1100 km from north to south. According to recent evidence, a high standard of living was reached which was reflected in almost all walks of life, including art, trade and commerce, social and religious life, town planning and architecture.

The first thing that strikes a visitor to an Indus site — be it Harappa or Mohanjo-daro in Pakistan, or Kalibangan, Lothal or Surkotada in India — is the town planning in terms of its, physical layout. Settlement patterns, streets and lanes were laid out according to a set plan.

At Mohanjo-daro and Kalibangan, where large areas have been excavated, an average house consisted of a courtyard around which were situated four to six living rooms, a bathroom and a kitchen. Larger houses, however, might have up to thirty rooms and the presence of stair cases in many of them indicates a second storey.

Most of the houses had their own wells. There were also public wells. The sullage water was discharged through covered drains made of burnt bricks. At intervals they were provided with manholes.

The most notable feature is the importance given to water supply, bathing and drainage. In some houses western type latrines have been found on the ground or first floor. A sloping and stepped channel passes through the wall to a pottery-receptacle or brick drain in the street outside.

The Great Bath at Mohanjo-daro is a good example of Indus water management technique. The tank measured 12 m in length, 7 m in width and 2.5 m in depth. It was approached by two stair cases, one each on the northern and southern sides. The floor and side walls of the tank were strengthened with gypsum and bitumen. Around the tank ran a pillared veranda from which there was access to a series of what might be called 'dressing rooms'.

The tank was fed with water from a large well situated in the complex. For the discharge of used water there was a drain in the south-west corner. The tank is a unique example of how people, even in those ancient times, planned to store and dispose the waste water.

Case Study

Water Management in Sukhomajri

Sukhomajri is a village of some 70 families nestled in the Sivalik Hills near Chandigarh, in the foothills of the Himalayas. The village is one of the many that lie within the catchment area of Sukhna Lake, a popular boating and picnic spot for the people of Chandigarh. When Sukhna Lake began to get silted about 20 years ago, the government of Chandigarh decided to find out why.

What they found was interesting. Cattle and goats grazing on the hillsides in the catchment had made the hills bare. The soil was running off into the streams and river that fed Sukhna Lake, causing the lake to fill up with silt. In the worst affected places like Sukhomajri, large chunks of land were sliding into ravines around the deep gorge of the Sukhna River. The village itself was in danger of being swallowed up.

At the same time, villagers were suffering because of low water levels. The barren land could not hold water, and rainwater simply ran off the hills to the river below, carrying rocks, sand and soil with it. The problem was how to hold the water over the soil so that it could be used by Sukhomajri village, and at the same time stop it from carrying their soil away.

The Central Soil and Water Conservation Research and Training Institute helped the villagers of Sukhomajri build three small reservoirs to collect rainwater for irrigating their land. The villagers, for their part, planted trees and grasses on the hillsides and stopped letting their cattle graze freely. As a result plants grew back to cover the slopes. The plant cover helped slow down the water so that it began to soak into the ground instead of just running off. Village wells and local springs benefited from the resulting higher groundwater level.

The village formed a Hill Resource Management Society in which every villager was an equal member. The Society made sure that everyone shared in the profits of the water conservation project. The people also created a Water Users' Association. A water-sharing system was set up by the Association, whereby each family, whether it owned land in the village or not, was given a 'water coupon'. The family could use the coupon or sell it to someone else. Since there are no tubewells in the village, local farmers depended on the water from the reservoirs to irrigate their crops. With the water-sharing system, each farmer could get the water he needed.

The result of the project was less soil erosion and a constant water supply for the village. The area around Sukhomajri is now covered with grasses, shrubs and trees. Local crop production is much higher with the use of the reservoir water for irrigation. Other villages in the region have started their own programmes like the one at Sukhomajri. And the villagers of Sukhomajri are now profiting from a programme that they themselves helped to build.

Case Study

The Stepwells of Gujarat

A stepwell is one of the various existing well monuments in India. It is found in its most intricate and complicated form in Gujarat. Stepwells have survived since the seventh century. Probably the last stepwell was built in the palace gardens of Wankaner in 1935.

The typical feature of a stepwell is that its major parts are underground, often descending five or six storeys, and in their elaborateness resembling subterranean temples.

A stepwell consists of three parts: the vertical well with an arrangement for hauling up water, the stepped corridor leading down several storeys from the entrance pavilion of the well, and numerous intermediate pavilion constructions built as open halls in the stepped corridor. The pavilion at the entrance is normally a simple, open, pillared hall. From here a flight of steps leads down to the next lower storey being the first pavilion, and down to the second pavilion, and so on. In this way the flight of steps proceeds downwards into the earth interrupted at regular distances by the pavilions. Often there is a quadrangular or octagonal pool at the lowest level. This pool is surrounded by decorative stairs, pillars, supporting beams and niches in the walls.

The most exquisite example of stepwell construction is in the village of Adalaj. It was built in AD 1500 by Rudabai, the wife of the Vaghela chief Virasimha. With its 70 m depth it is one of the largest and most impressive monuments of its kind. It is one of the very few examples that have three entrance stairs leading towards the stepped corridors. The corridors descend into four pavilion constructions for five storeys underground. This stepwell is an exquisite example of post-Chalukya architecture in Gujarat.

Case Study

Water Treatment Process in Akividu

Kolleru is a large lake on the east coast of the Godavari river basin. The lake occupies a low lying area in the river basin and is filled by several drains and canals from the river. The water thus collected discharges into the Bay of Bengal through a narrow and shallow drain called Upputeru.

During the 1986 floods, the lake was polluted by wastes and sewage from neighbouring areas. People consuming the contaminated water, especially children, suffered from water-borne diseases. Arthik Samatha Mandal, a voluntary organization realized the urgent need to supply potable water in the village. It constructed water tanks in Kolleru to treat and purify the lake water before being consumed by the villagers.

The tank system consisted of a large tank within which there were three smaller tank units of different capacities. The first tank was called the raw water storage tank, the second the filteration bed, and the third the fresh water storage tank. The tanks were brick-lined and reinforced with cement-concrete pillars.

The water from drainage canals was pumped into the first tank (raw water storage tank) by means of a hand-operated lift pump. Here sedimentation took place and the sedimented water flowed through pipes into the second tank. From here the water flowed through sand filter beds. The filtered water was stored in the third tank. Taps were fixed to the third tank from which people could collect water.

The tanks were set up in such a manner that the water flowed from one tank to the other tank by gravity force. The initial process of filtration took about five hours. After which there was a continuous flow of water to the taps.

Water Analysis Report:

Parameters	Before treatment	After treatment
1. Turbidity	200 units	Less than 5
2. pH	8	7.5
3. Flouride	6 parts/million	2.5 parts/million
4. Bacterial count	Too numerous to count	20/Litres
5. Dissolved solids	1000 units	400

Bacterial count is being further reduced by chlorinating the water.Four water tanks have been installed in different villages. A total of 2,000 families are getting drinking water of potable quality.

Source : Arthik Samata Mandal, Vijayawada.

Case Study

Cleaning the Ganga

One of the most polluted rivers in India is the Ganga. This great river, flowing from the Himalayas to the Bay of Bengal, drains one-fourth of India's land area. It supports millions of people who live in towns, cities and villages along its 2,500 km course. These people rely on the waters of the Ganga for drinking, for industrial uses and for irrigating their land. The Ganga is also used by millions more who come to bathe in and drink the water of the most sacred of Indian rivers.

Each city and town adds its own wastes to the Ganga. Most of this is untreated human sewage (none of the 112 towns and cities along the Ganga has full sewage treatment facilities). The rest of the pollution comes from domestic garbage, industrial sewage, carcasses of animals and human corpses thrown into the river, and run-off from crop lands.

Even though the Ganga has a high capacity for self-cleansing, it cannot keep up with all the wastes dumped into it. In many cities, the water is unfit for drinking, cooking, or bathing. Further downstream the quality improves, as the river's natural self-purification system has a chance to work. But then there is another city, town, or factory dumping its untreated waste right into the Ganga.

One of the most polluted stretches is the seven-kilometre curve at Varanasi, where six million devotees come each year to bathe in (and add their dirt to) the holy river. Unfortunately, they are not the only things going into the water. About 100 million litres of untreated sewage is dumped each day into the same stretch of river. An industrial estate located upstream of Varanasi city dumps wastes from coalyards, a paper mill; insecticide firms and glass works. And the ashes of some 40,000 bodies, along with the unburnt or half-burnt bodies of 10,000 more, are also dumped into the Ganga at Varanasi and other places each year. Another 60,000 animal carcasses — cows, dogs and donkeys — add to the problem. Pesticides and fertilizers from fields drain into the streams and rivers that feed the Ganga. Finally, industrial sewage adds toxic chemicals and metals to the polluted river.

India has much to lose by polluting its water supplies. We cannot afford to keep dumping our wastes into the same rivers from which we draw out drinking water. And there is no truth to the myth that the Ganga can never be polluted. We have already shown that it can be. The task before us now is to make Ganga pure once again.

Recognizing the magnitude of this problem, the Government of India, in February 1985, set up the Central Ganga Authority for the planning and execution of a programme to prevent the pollution of the river, and since then the Ganga Action Plan has been working towards cleaning the river.

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RETURN DATE SLIP

DUE DATE	DUE DATE	DUE DATE